addendum #01

project: ETSU IPER Center (Building 60 Renovation)  

to: Nick Self – BurWil Construction, CM/GC  

from: Patrick Core – Red Chair Architects  

220 W. Jackson Avenue  
Knoxville, TN 37902  

date: 08/11/16

This Addendum forms a part of the Contract Documents and modifies the original Bidding Documents dated 06/24/16 as noted below. All such modifications, amendments, and/or supplements shall be considered as through originally specified and/or shown on the Drawings or in the Specifications. This Addendum shall be acknowledged on the Bid Form. Failure to do so may subject Bidder to disqualification. All parties receiving this document are responsible for reviewing all items included in this Addendum regardless of headings as listed herein.

This Addendum consists of Four (4) pages and the attached Drawings and Specifications as listed below. Refer to bubbled areas on attached Drawing sheets for changes.

attachments:
1. Project Manual (1304 pages - 8-1/2” x 11”)
2. Drawing Set (198 pages - 24”x36”).
3. Request for Equivalency  
   a. Stair C and railing to remain  
   b. Stair C as communicating space

changes to prior Addenda:  
4. None

changes to Bidding Requirements:  
5. None

changes to Agreement:  
6. None

changes to Conditions of the Contract:  
7. None

changes to Specifications:  
8. Section 00 01 10 – Table of Contents : Refer to highlighted areas for revised specification sections.

changes to Drawings:  
9. Sheet G001: Sheets added to Index of Drawings.  
10. Sheet G002: Index of Abbreviations edited/amended.  
11. Sheet G101: Drawings 1 and 2 have been revised. Refer to bubbled area.  
12. Sheet G102: Drawings 1 and 2 have been revised. Refer to bubbled area.
13. Sheet G111: Assembly FC-22 added to Calculated Fire Resistance Table. Refer to bubbled area.
15. Sheet C001: Notes revised.
17. Sheet C102: Sidewalk revised at west. Utilities updated. Point of Service note added. ADA accessible route diagram added. Refer to bubbled areas.
21. Sheet C201: Notes revised.
22. Sheet C202: Detail 7 added.
23. Sheet AS101: Drawing 1 “Work Area Boundary” has been revised. Refer to bubbled area.
24. Sheet AS102: Drawing 1 “Work Area Boundary” has been revised. Refer to bubbled area.
25. Sheet AS103: Drawing 2 depth of rail sleeve has been revised. Refer to bubbled area.
26. Sheet AS105: Drawings revised and/or added to sheet.
27. Sheet AD100: Drawing 1 keynotes have been revised. Refer to bubbled areas.
28. Sheet AD101: Drawing 1 keynotes have been revised. Refer to bubbled areas.
29. Sheet AD102: Drawing 1 keynotes have been revised. Refer to bubbled area.
30. Sheet AD103: Drawing 1 has been revised. Refer to bubbled areas.
31. Sheet AD801: Existing Door Schedule has been revised. Refer to bubbled area.
32. Sheet A100: Drawing 1 has been revised. Refer to bubbled areas.
33. Sheet A101: Drawing 1 has been revised. Refer to bubbled areas.
34. Sheet A102: Drawing 1 has been revised. Refer to bubbled areas.
35. Sheet A103: Drawing 1 has been revised. Refer to bubbled areas.
36. Sheet A104: Drawing 2 has been revised, clarifying areas of work. Refer to bubbled area.
37. Sheet A110: Drawing 2 has been revised. Refer to bubbled areas.
38. Sheet A112: Horizontal Assembly Schedule has been revised. Refer to bubbled area.
39. Sheet A202: Drawing 2 has been revised. Refer to bubbled areas.
40. Sheet A311: Drawings have been revised. Refer to bubbled areas.
41. Sheet A312: Drawings have been revised. Refer to bubbled areas.
42. Sheet A313: Sheet added.
43. Sheet A400: Entire sheet revised.
44. Sheet A411: Sheet added.
47. Sheet A411: Drawing 9 added. General Notes - Elevator have been amended. Drawing 2 has been revised. Refer to bubbled areas.
48. Sheet A412: Drawing 1 has been revised. Refer to bubbled area.
49. Sheet A412: Drawings 1, 2, 5 and 6 have been revised. Refer to bubbled areas.
50. Sheet A415: Entire sheet revised.
51. Sheet A416: Drawings 1, 2, 15, 16, 17 and 18 have been revised. Refer to bubbled areas.
52. Sheet A510: Sheet added.
53. Sheet A500: Sheet added.
54. Sheet A502: Sheet added.
55. Sheet A503: Sheet added.
56. Sheet A510: Sheet added.
57. Sheet A511: Sheet added.
58. Sheet A512: Sheet added.
59. Sheet A513: Sheet added.
60. Sheet A601: Entire sheet revised.
61. Sheet A603: Sheet added.
63. Sheet A801: Glazing/Panel Legend has been revised.
64. Sheet A802: Glazing/Panel Legend and Drawing 1 have been revised. Refer to bubbled areas.
65. Sheet A803: Glazing/Panel Legend and Drawing 1 have been revised. Refer to bubbled areas.
66. Sheet A810: Glazing/Panel Legend has been revised.
68. Sheet A820: Drawings have been revised. Refer to bubbled areas.
69. Sheet A821: Drawings have been revised and added. Refer to bubbled areas.
70. Sheet A822: Drawings have been revised. Refer to bubbled areas.
71. Sheet A823: Sheet added.
72. Sheet A831: Drawings 7-15 have been revised and/or added.
73. Sheet I100: Drawing 1 has been revised. Refer to bubbled area.
74. Sheet S100: Foundation information has been revised. Details 2 and 3 have been added.
75. Sheet S101: Stair Floor Framing Plan has been revised. Details 4, 5 and 6 have been added.
76. Sheet S102: Additional information added to plan. Details 4 has been added. Sheet S103: Additional information added to plan. Refer to bubbled area.
77. Sheet S104: Additional information added to plan. Detail 1 has been added.
78. Sheet S202: Additional information added to details. Detail 11 has been added.
79. Sheet FA100: Additional devices and information added to plans. Wall legend added.
80. Sheet FA101: Additional devices and information added to plans. Wall legend added.
81. Sheet FA102: Additional devices and information added to plans. Wall legend added.
82. Sheet FP001: Riser Detail, System Protection Areas, and Hydraulic Graph revised. Refer to bubbled areas.
83. Sheet FP100: Additional information added to plans. Wall legend added.
84. Sheet FP101: Additional information added to plans. Wall legend added.
85. Sheet FP102: Additional information added to plans. Wall legend added.
86. Sheet FP103: Additional information added to plans. Penthouse Plan added.Wall legend added.
87. Sheet P001: Plumbing fixture schedule revised.
88. Sheet P002: Water heater detail revised.
89. Sheet P003: UL details added.
90. Sheet P100: Additional information added to plans. Wall legend added.
91. Sheet P101: Additional information added to plans. Wall legend added.
92. Sheet P102: Additional information added to plans. Wall legend added.
93. Sheet P103: Additional information added to plans. Wall legend added.
94. Sheet P200: Additional information added to plans. Wall legend added.
95. Sheet P201: Additional information added to plans. Wall legend added.
96. Sheet P202: Additional information added to plans. Wall legend added.
97. Sheet P203: Additional information added to plans. Wall legend added.
98. Sheet M001: Schedule revised.
100. Sheet M003: Schedules revised.
101. Sheet M004: Details added.
102. Sheet M004: Details revised.
103. Sheet M005: Details revised.
104. Sheet M006: Details revised.
105. Sheet M007: UL detail added.
106. Sheet M008: Control sequence revised.
107. Sheet M009: Control sequence revised.
108. Sheet M010: Control sequence revised.
109. Sheet M011: Control sequence revised.
110. Sheet M012: Control sequence revised.
111. Sheet M012: Section 1 revised.
112. Sheet M013: Section 1 and 3 revised.
113. Sheet M100: Additional information added to plans. Wall legend added.
114. Sheet M101: Additional information added to plans. Wall legend added.
115. Sheet M102: Additional information added to plans. Wall legend added.
116. Sheet M103: Additional information added to plans. Wall legend added.
117. Sheet M104: Additional information added to plans.
118. Sheet M200: Additional information added to plans. Wall legend added.
119. Sheet M201: Additional information added to plans. Wall legend added.
120. Sheet M202: Additional information added to plans. Wall legend added.
121. Sheet M203: Additional information added to plans. Wall legend added.
122. Sheet M204: Additional information added to plans. Wall legend added.
123. Sheet ES100: Notes revised. Information added to plan.
124. Sheet E001: Schedule and legend revised.
125. Sheet E002: UL details added.
126. Sheet E004: Details deleted.
127. Sheet E005: Panel Schedule revised.
128. Sheet E006: Panel Schedule revised.
129. Sheet E007: Panel Schedule revised.
130. Sheet E008: Panel Schedule revised.
131. Sheet E100: Additional information added to plans. Wall legend added.
132. Sheet E101: Additional information added to plans. Wall legend added.
133. Sheet E102: Additional information added to plans. Wall legend added.
134. Sheet E103: Additional information added to plans. Wall legend added.
135. Sheet E200: Additional information added to plans. Wall legend added.
136. Sheet E201: Additional information added to plans. Griddle removed from schedule. Wall legend added.
137. Sheet E202: Additional information added to plans. Wall legend added.
138. Sheet E203: Additional information added to plans. Wall legend added.
139. Sheet E300: Additional information added to plans. Wall legend added.
140. Sheet E301: Additional information added to plans. Wall legend added.
141. Sheet E302: Additional information added to plans. Wall legend added.
142. Sheet E303: Additional information added to plans. Wall legend added.
144. Sheet T001: Schedule and detail revised.
145. Sheet T002: Detail revised.
146. Sheet T100: Additional information added to plans. Wall legend added.
147. Sheet T101: Additional information added to plans. Wall legend added.
148. Sheet T102: Additional information added to plans. Wall legend added.
149. Sheet T103: Additional information added to plans. Wall legend added.
150. Sheet T104: Plan revised.
151. Sheet T104: Detail deleted.
152. Sheet T202: Additional information added to plans. Wall legend added.
153. Sheet T203: Additional information added to plans. Wall legend added.

clarifications:
154. None

end of addendum
REQUEST FOR EQUIVALENCY

The 2006 editions of the IBC, IFC, and NFPA 101 are currently adopted by this office. IBC, Section 104.11, IFC, Section 104.9, and NFPA 101, Section 1.4, allow the Authority Having Jurisdiction (AHJ) to permit alternative systems, methods, or devices that differ from those prescribed by the applicable Code. These systems, methods, or devices must be equivalent or superior to those required by code. This form must be completed by the building designer and approved by this office prior to plan approval.

Please note that all approvals are specific to the project indicated below only and are not necessarily transferable to other projects. (use attachments if necessary)

Date: 7/27/2016
Project #: 2016-026-29-05
TFM #: 07492-1111
City: Johnson City
Project Name: ETSU IPER Ctr - Bldg # 60
County: Washington
Address: 69 Dogwood Avenue
Registration Number: 017814
Architect/Engineer: David Cockrill, Red Chair Architects

Identify the Code(s) Section(s) that the equivalency is requested to replace:
2006 NFPA 101 43.10.5.7.2

Identify the alternative system, method, or device:
See Attachment A

Explain how this alternative is equivalent or superior to that required by the Code:
See Attachment A

<table>
<thead>
<tr>
<th>OFFICE USE</th>
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<tbody>
<tr>
<td>□ APPROVED</td>
</tr>
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</table>

Signature of Plans Supervisor

Signature of Fire Safety Manager

Date:

Date:

Revised 07-31-12
ATTACHMENT A - REQUEST FOR EQUIVALENCY

Re: Stair C and associated rail existing to remain

ETSU IPER Center (Bldg 60)

July 27, 2016

Rickey Cottrell
State Fire Marshal's Office | Codes Enforcement – Facilities Construction Specialist III
Davy Crockett Tower, Tenth Floor
500 James Robertson Parkway
Nashville, Tennessee 37243-1162

Identify the alternative system, method, or device:

Location: Stair C (shown in attached plans)

Stair C is an existing stair connecting 4 levels (see attached photos). The existing treads and risers are approximately 7.5” rise / 10.5” run. There is an existing pipe handrail in the center of the stair approx. 34” high (irregular) with one intermediate horizontal pipe (in most locations) at 15.5” above the nosings. The proposal is to keep the existing stair and historic center rail. (Note: A new 42” high guardrail per requirements for new construction is proposed at the top of the stair opening to sit behind the existing guard to remain, so no equivalency is requested there.)

Stair C is not a designated path for egress and is not an “exit stair”. New exit stairs are proposed for egress in new locations at each end of the building. The building is historic and is undergoing a change of occupancy to a higher hazard group (from storage to business), therefore, the provisions of 2006 NFPA 101 43.10.5 apply.

Explain how this alternative is equivalent or superior to that required by the Code:

2006 NFPA 101 43.10.5.7.2 requires the acceptance of the authority having jurisdiction for grand stairways and associated handrails in historic buildings undergoing a change of occupancy.

2006 IBC 3407 exempts historic buildings from requirements “if judged by the building official to not constitute a distinct life safety hazard”.

redChair: architects
REQUEST FOR EQUIVALENCY

The 2006 editions of the IBC, IFC, and NFPA 101 are currently adopted by this office. IBC, Section 104.11, IFC, Section 104.9, and NFPA 101, Section 1.4, allow the Authority Having Jurisdiction (AHJ) to permit alternative systems, methods, or devices that differ from those prescribed by the applicable Code. These systems, methods, or devices must be equivalent or superior to those required by code. This form must be completed by the building designer and approved by this office prior to plan approval. Please note that all approvals are specific to the project indicated below only and are not necessarily transferable to other projects. (use attachments if necessary)

Date: 7/27/2016
TFM #: 07492-1111
Project #: 2016-026-29-05
City: Johnson City
Project Name: ETSU IPER Ctr - Bldg # 60
Address: 69 Dogwood Avenue
County: Washington

Identify the Code(s) Section(s) that the equivalency is requested to replace:
2006 NFPA 101 43.10.5.7.2

Identify the alternative system, method, or device:
See Attachment A

Explain how this alternative is equivalent or superior to that required by the Code:
See Attachment A

<table>
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<th>OFFICE USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ APPROVED</td>
</tr>
<tr>
<td>□ DENIED  Date:</td>
</tr>
</tbody>
</table>

Signature of Plans Supervisor

Signature of Fire Safety Manager

Revised 07-31-12
ATTACHMENT A - REQUEST FOR EQUIVALENCY

Re: Stair C Communicating Space

ETSU IPER Center (Bldg 60)

July 27, 2016

Rickey Cottrell
State Fire Marshal’s Office | Codes Enforcement – Facilities Construction Specialist III
Davy Crockett Tower, Tenth Floor
500 James Robertson Parkway
Nashville, Tennessee 37243-1162

Identify the alternative system, method, or device:

Location: Stair C (shown in attached plans)

Stair C is an existing historic stair connecting 4 levels at the core of the building. The existing walls at the sides of the stair area are existing brick masonry approximately 12 inches thick. This project proposes to infill openings in the existing walls and place new walls at the north end of the stair area at each level for enclosure. Because the area will have penetrations for ducts, electrical, etc. not related to the use of the stair, the area is proposed as a “communicating space” per 2006 NFPA 101 8.6.6. Note: the stair is not a designated path for egress and is not an “exit stair”.

Explain how this alternative is equivalent or superior to that required by the Code:

2006 NFPA 101 8.6.6 (1) requires that the communicating space not connect more than 3 stories and that (4a) it is separated by a smoke barrier (the building is fully sprinklered). This design proposes a 2 hour fire barrier enclosure at all levels.
addendum #02

project: ETSU IPER Center (Building 60 Renovation)  
rc 13-024  SBC 166/005-06-2013

to: Nick Self – BurWil Construction, CM/GC

from: Patrick Core – Red Chair Architects  
220 W. Jackson Avenue  
Knoxville, TN 37902

date: 09/14/16

This Addendum forms a part of the Contract Documents and modifies the original Bidding Documents dated 06/24/16 as noted below. All such modifications, amendments, and/or supplements shall be considered as through originally specified and/or shown on the Drawings or in the Specifications. This Addendum shall be acknowledged on the Bid Form. Failure to do so may subject Bidder to disqualification. All parties receiving this document are responsible for reviewing all items included in this Addendum regardless of headings as listed herein.

This Addendum consists of Two (2) pages and the attached Drawings and Specifications as listed below. Refer to bubbled areas on attached Drawing sheets for changes.

attachments:
1. Revised specifications (59 pages - 8-1/2" x 11")
2. Revised drawings (26 pages - 24" x 36")

changes to prior Addenda:
3. None

changes to Bidding Requirements:
4. None

changes to Agreement:
5. None

changes to Conditions of the Contract:
6. None

changes to Specifications:
7. Section 00 01 10 – Table of Contents : Refer to highlighted areas for revised specification sections.
8. Section 00 01 19 – Request for GMP : updated section
9. Section 00 22 13 – Supplementary Instructions To Bidders : new section
10. Section 00 31 19 – Existing Condition Information : updated section
11. Section 00 31 25 – Wood Advisory Services' Condition Assessment : added section
12. Section 09 68 13 – Tile Carpeting : Refer to Part 2.2, C Moisture Barrier Underlayment - delete this item entirely.
13. Section 09 65 13 – Resilient Tile Flooring : Refer to Part 2.4, F Moisture Barrier Underlayment - delete this item entirely

changes to Drawings:
15. Sheet V100: Sheet stamp updated.
16. Sheet C102: Location of fire hydrant has been revised. It is now located on the south side of Maple Avenue.
17. Sheet AD100: Extent of existing demolished slab updated. General Note #20 added.
18. Sheet AD110: Extent of paint abatement revised. Refer to bubbled areas.
19. Sheet AD113: Extent of paint abatement revised. Refer to bubbled areas.
20. Sheet A120: General Note #6 added.
23. Sheet A500: "MB" designation removed. C-1 Floor Designation revised. Refer to bubbled areas.
27. Sheet AV102a: Sheet revised.
28. Sheet AV103: Sheet revised.
29. Sheet AV103a: Sheet revised.
30. Sheet AVE102: Sheet revised.
31. Sheet AVE102a: Sheet revised.
32. Sheet AVE103: Sheet added.
33. Sheet AVE103a: Sheet added.
34. Sheet AV.A1: Sheet added.
35. Sheet AV.C1: Sheet added.
36. Sheet AV.N1: Sheet added.
37. Sheet AV.V1: Sheet added.
38. Sheet FP001: square footage revised.
39. Sheet M102: Additional information added to plan.

clarifications:
40. None

end of addendum
addendum #03

project: ETSU IPER Center (Building 60 Renovation)  
rdc 13-024  SBC 166/005-06-2013

to: Nick Self – BurWil Construction, CM/GC

from: Patrick Core – Red Chair Architects  
220 W. Jackson Avenue  
Knoxville, TN 37902

date: 10/17/2016

This Addendum forms a part of the Contract Documents and modifies the original Bidding Documents dated 06/24/16 as noted below. All such modifications, amendments, and/or supplements shall be considered as through originally specified and/or shown on the Drawings or in the Specifications. This Addendum shall be acknowledged on the Bid Form. Failure to do so may subject Bidder to disqualification. All parties receiving this document are responsible for reviewing all items included in this Addendum regardless of headings as listed herein.

This Addendum consists of Two (2) pages and the attached Drawings and Specifications as listed below. Refer to bubbled areas on attached Drawing sheets for changes.

attachments:
1. FSC Addendum #3 dated 10/17/16 (4 pages - 8-1/2" x 11")
2. Substitution Request, Flush Wood Doors (13 pages - 8-1/2" x 11")
3. Revised specifications (67 pages - 8-1/2" x 11")
4. Revised drawings (31 pages - 24" x 36")

changes to prior Addenda:
5. Addendum 1, changes to drawings, Item 20 – Insert item 20a: C106: Detail revised.

changes to Bidding Requirements:
6. None

changes to Agreement:
7. None

changes to Conditions of the Contract:
8. None

changes to Specifications:
9. Section 00 01 10 R3 – Table of Contents : Refer to highlighted areas for revised specification sections.
10. Section 00 11 19 R2 – Request for GMP: Roof bond requirements updated.
11. Section 01 21 13 – TBR Allowances: Section removed.
12. Section 01 21 15 – List of Allowances: Section removed (see 01 22 15 for unit price quantity allowances
13. Section 01 22 15 R3 – List of Unit Price Items: Base quantities updated.
14. Section 01 23 00 R2 – Alternates – section added.
15. Section 01 50 00 R2 – Temporary Facilities and Controls, Part 3.2 – contact information updated.
16. Section 01 78 39 R3 – Project Record Documents – see revised language
17. Section 07 01 50.19 R1 – Preparation for Re-Roofing – section added
19. Section 07 21 19 – Foamed In Place Insulation – section updated.
20. Section 07 31 00 R1 – Slate Roofing – section added
21. Section 07 50 35 R1 – Roof Warranty Execution – section added
22. Section 07 50 36 R1 – Roof Warranty – section added.
23. Section 08 91 19 R2 – Fixed Louvers – section updated.
25. Section 22 08 00 – Plumbing Systems Commissioning – section added.
26. Refer to FSC Addendum #3 for further information.

changes to Drawings:
27. Sheet G001: R3 – Index updated.
28. Sheet G102: R2 – Location of FEC updated at Corridor 294.
29. Sheet AS102: R2 – Trees & shrubs not in contract
30. Sheet AD101: R2 – Plan / scoping updated
31. Sheet A102: R2 – Plan revised at Corridor 294
32. Sheet A201: R1 – Gutters & Downspouts may be replaced or repaired
33. Sheet A414: R2 - Updated plans & axon
34. Sheet A415: R2 - Updated sections/interior elevations.
35. Sheet A416: R2 - Updated details.
36. Sheet A417: R1 - Updated details.
37. Sheet A500: R3– Updated floor finishes
38. Sheet A501: R2 – Updated floor finishes at entrances
39. Sheet A502: R2– Updated floor finishes
40. Sheet A503: R2– Updated floor finishes
41. Sheet A510: R2 – Updated finishes
42. Sheet A511: R2 – Updated finishes
43. Sheet A512: R2 – Updated finishes
44. Sheet A513: R2 – Updated finishes
45. Sheet A601: R1 – Updated interior elevations & finishes
46. Sheet A603: R2 - Updated interior elevations & finishes
47. Sheet A801: R2 – Updated doors / muntin patterns
48. Sheet T001: R2 – Refer to bubbled areas
49. Sheet T100: R2 – Refer to bubbled areas
50. Sheet T101: R2 – Refer to bubbled areas
51. Sheet T102: R2 – Refer to bubbled areas
52. Sheet T103: R2 – Refer to bubbled areas
53. Sheet T104: R2 – Refer to bubbled areas
54. Sheet T107: R1 – Refer to bubbled areas
55. Sheet T108: R1 – Refer to bubbled areas
56. Sheet T202: R2 – Refer to bubbled areas
57. Sheet T203: R2 – Refer to bubbled areas
58. Refer to FSC Addendum #3 for further information.

clarifications:
59. None

end of addendum
ADDENDUM NUMBER 3
A Renovation Project for
ETSU Building 60 IPER Center
Johnson City, Tennessee
October 17, 2016

Changes/Modifications to the Drawings and Specifications:

Mechanical

1. Section 23.09.23 “Direct Digital Control (DDC) System for HVAC”: Add the following:

*2.4 H. Volumetric Devices: Fan Inlet Air Flow Probes and Indicating Transmitters

1. Fan inlet air flow sensors and indicating transmitters shall be factory mounted in the air handling units. Fans shall be supplied with a factory mounted complete air flow measuring system and shall consist of total and static pressure pick-ups at various positions around the fan inlet cone throat and intake wall. The flow measuring station shall not obstruct the inlet to the fan and shall not have any effect on fan performance (flow or static pressure) or fan sound power levels. Traverse probes located in the fan inlet will not be acceptable due to increased noise levels and decreased fan efficiency. The flow measuring station shall be piezometer type as manufactured by Twin Cities or approved equal. Airflow sensing accuracy shall be +/- 5% of measured flow.

2. For fan locations outside of air handling unit where factory mounted inlet sensor type cannot be used, fan inlet probes shall be pitot type average velocity sensors designed for installation inside the inlet bell/funnel of in-line centrifugal fans. Provide fan inlet airflow measuring probes with +/- 2% accuracy to be Paragon Controls Inc. FE-1050 or Air Monitor equivalent.

3. The airflow transmitter shall be an industrial quality, electronic solid state, low range, +/- 0.25% accuracy transmitter with integral square root, scaling, and output filter with indication. Each transducer shall be provided with an indicating meter operating independent of all other control devices which provides a direct readout of the air volume as derived from the static input signals received from the respective air flow measuring element. The meter shall be a differential pressure type that is diaphragm actuated and is flush mounted on the enclosure door. The meter shall be calibrated to an accuracy of +/- 2% measured flow. Provide individual airflow transmitters, especially selected for the required spans of each of the above primary elements to be Paragon Controls Inc. as required for applicable range with auto.

4. Factory technician from home office to visit site and provide written certification that Paragon inlet probes and airflow transmitters have been installed and are functioning per manufacturer's requirements*

2. Sheet M001 “VAV Box Schedule”:

Omit note below VAV schedule regarding control transformers. All control transformers shall be as specified in Section 23 36 00.
3. Sheet M003 “Fan Coil Unit Schedule”:

Revise Heating Capacity to 9850 BTUH for FCU’s 1-3, 1-4, 1-5, 1-6, 1-7, 1-9, 1-10, 1-13, 1-14, 1-15, 1-18, 1-19, 2-1, 2-3, 2-5, 2-2-7, 2-8, 2-9, 2-10, 2-11, 2-12, 2-13, 2-14, 2-15, 2-16, 2-17, 2-23. Thermostats shall be by the control contractor. Two way control valves serving Fan Coil Units shall be by fan coil unit manufacturer.

4. Sheet MS101

Revise routing of 3” steam and 2” steam condensate to miss the Tree drip line. Allow an additional 40 feet of piping to avoid the tree line. Underground steam and steam piping submittals to include location of moment guides, anchors and expansion loops.

5. Section 23.21.23 Hydronic Specialties

Add Armstrong to the list of manufacturers.

6. Sheet M001 “VAV Box Schedule”:

Revise VAV 04 to 550 primary cfm, 200 minimum cfm, and 380 heating cfm. VAV 04 to be a 8 inch box with 16.5 MBH heating and 1.1 gpm.

7. Sheet M100:

Revise two supply registers in Restroom- Space -B55 to 8 x 6 & 125 cfm instead of 6 x 6, 50 cfm each. Revise the low pressure supply ductwork serving VAV 03 to a 10 x 10. Connect a 8 inch round to a diffuser sized for 150 cfm to serve Corridor adjacent to the water coolers.

8. Sheet M101:

Revise two supply registers in Restroom- Space -155 to 8 x 6 & 125 cfm instead of 6 x 6, 50 cfm each. Revise the low pressure supply ductwork serving VAV 1-11 to a 12 x 10. Connect a 10 inch round to a diffuser sized for 265 cfm to serve Corridor outside Electrical Room 151.

9. Sheet M102:

Revise two supply registers in Restroom – Space - 255 to 8 x 6 & 125 cfm instead of 6 x 6, 50 cfm each. Revise the low pressure supply ductwork serving VAV 2-6 to a 12 x 10. Connect a 8 inch round to a diffuser sized for 170 cfm to serve Corridor outside Electrical Room 251.

10. Sheet M103:

Revise two supply registers in Restroom- Space -355 to 10 x 6 & 150 cfm instead of 6 x 6, 50 cfm each. Revise the low pressure supply ductwork serving VAV 3-11 to a 12 x 10.

11. Specification 23 64 23 Scroll Water Chillers

Add manufacturer Diakin to 2.1 A.
12. Specification 23 36 00 Variable Volume Terminal Units

Add manufacturer Price to 1.1 A.

13. Specification 23 73 13 Modular Indoor Central Station Air Handling Units

Add manufacturer Diakin to 2.1 A.

Plumbing

1. WC3 shall be a tank type water closet equal to that of Zurn Z5551, 1.5 gpf.

Fire Protection

1. Backflow on fire riser shall be equal to Zurn Wilkins 375.

Electrical

1. Refer to Specification Section 27 15 00 - VOICE AND NETWORK HORIZONTAL CABLE LING SYSTEM. Refer to Part 2 – Products, 2.1 Materials. Replace paragraph “E” with the following:

Voice and network horizontal cabling: Cabling shall be as specified in ITS Guidelines, Appendix A. All network cabling shall have blue outer insulation. Leave 8" of slack for each termination at wall outlet location. Leave one meter (3.28') slack at the end of each conduit run. Cable slack shall not be stored in bundled loops. Cable slack shall be stored in an extended loop or in a Figure 8 configuration. Provide two data cables to each communications outlet illustrated on the drawings, unless noted otherwise.

2. Refer to Drawing E001 – Electrical Legend, Details, and Notes

a. Refer to the Legend. Refer to the symbols for standard and counter-height duplex and quad receptacles. Revise last sentence to indicate that USB Charging Type receptacles are required in Corridors, Conference Rooms, Orientation/Debrief Rooms, Commons, Lobbies, and other public spaces only.

b. Refer to Lighting Fixture Schedule.

i. Revise last column to be titled “Alternate Manufacturers”.

ii. For fixture types A, A1, B, B1, D, and G note in fixture Description that these fixtures shall have a 10 year warranty for all fixture components.

iii. For fixture type G, note in fixture Description that this fixture type is direct only, omit reference to “Top Glow Lens”.

iv. Revise catalog number for type H to be “STR4 LED35 M0 8’ TWM D1 SC INV X7 ND”. Note in fixture Description that this fixture type shall have a trim-less mud-over flange.

v. For fixture type W, note in Description that this fixture type shall be equipped with conduit knock-outs on all four sides for direct conduit entry.

vi. At bottom of fixture schedule revise Note 3 to read: “ALL FIXTURES SHALL BE FURNISHED COMPLETE WITH LAMPS AND DRIVERS. UNLESS NOTED OTHERWISE, LED LAMPS SHALL BE 3500K, WITH A MINIMUM CRI OF 82. LED DRIVERS SHALL BE ELECTRONIC WITH A MAXIMUM THD OF 10 PERCENT.”

vii. At bottom of fixture schedule add Note 4 to read: “THE CATALOG NUMBER ABOVE IS THE BASIS OF DESIGN. THE ALTERNATE MANUFACTURERS LISTED ARE PRE-APPROVED ASSUMING THEIR PRODUCT MEETS..."
3. Refer to Drawing E005 – Panelboard Schedules. Refer to Panelboard “B0”, circuits 15 and 17. Revise load description to be “SPARE” in lieu of current description. Revise load to be 0 VA.

4. Refer to Drawing E007 – Panelboard Schedules. Refer to Panelboard “D2”, circuit 3. Revise load description to be “Dryer Booster Fan” in lieu of current description. Revise load to be 100 VA.

5. Refer to Drawing E101 – First Floor Lighting Plan.
   a. Refer to Room 107, Grab-N-Go. Add a type “J” can in center of space; omit short section of track lighting (type “C”) on East wall.
   b. Refer to Room 167, IPER GA. Change fixture type to “B” in lieu of “D” shown.

6. Refer to Drawing E103 – Third Floor Lighting Plan. Refer to Room 394 “Corridor”, just outside Room 323 “Elec”. Tag two fixtures in corridor at this location as type “A1”.

7. Refer to Drawing E200 – Basement Power Plan. Refer to Enlarged IT Room B52 & SIM AV B53 Power Plan. In IT Room B52, note 2nd Data Rack closest to the door as “future”. Omit power circuit and receptacles B0-15, 17.

8. Refer to Drawing E201 – First Floor Power Plan. Refer to Enlarged IT Room 152 Power Plan. In IT Room 152, add 3rd Data Rack closest to the door. Relocate end receptacles shown on Rack #2 to new Rack #3, power circuit and receptacles B1-7 & 8.

9. Refer to Drawing E202 – Second Floor Power Plan. Refer to Room 294 Corridor, on South wall adjoining IT Room 252. Relocate receptacle shown at that location to the short wall to the East adjoining Sim Clinic Exam Room 261.

10. Refer to Drawing E300 – Basement Mechanical Power. Refer to Boiler Room to the East of the B60. Adjacent to EF-2, add a 120 volt connection for EF-5 at 100 watts. Connect to same circuit, M1-9. Provide toggle type disconnect.

11. Refer to Drawing E302 – Second Floor Mechanical Power. Refer to Adv Kit/S.P. Break Room 214. Refer to clothes dryer in Northeast corner. In chase behind dryer add a 120 volt, connection at 80 watts for an inline booster fan. Extend branch circuit to panelboard D2, 1/2 – 2#12, 1#12G, to circuit number 3; 20A/1P breaker.

12. Refer to attached revised sheets T001, T100, T101, T102, T103, T104, T107, T108, T202, and T203.

THIS ADDENDUM SHALL BECOME A PART OF THE PROJECT MANUAL AND HAVE FULL EFFECT AS IF SUBMITTED WITH THE ORIGINAL DOCUMENTS.

October 17, 2016

By: Facility Systems Consultants, LLC
To: Reel Chair Architects

Attn:

Specified Item: Flush Wood Doors
Algonk, VT Industries, Amco, Inc.

Project: ETSU Com Bldg #60

Proposed Substitute: Eagers Industries

1. The following are attached (Mark all that apply):
   ✔ Complete Description
   ✔ Laboratory Tests
   ✔ Catalog
   ✔ Spec Data

   Information on the availability of maintenance services and replacement materials for proposed substitute(s)

   Names, addresses, and phone numbers of fabricators and suppliers for proposed substitute(s)

2. This substitution will have the following effects on dimensions, gauges, weights, etc.:
   NONE

3. This substitution will have the following effects on wiring, piping, ductwork, etc.:
   NONE

4. This substitution will have the following effects on other trades:
   NONE

5. This substitution will have the following effect on construction Schedules:
   NONE

6. The proposed substitute(s) differs from the specified product(s) in quality and performance as follows:

7. Manufacturers guarantees for the substitute(s) and the specified product(s) are (check one):
   ✔ the same
   ☐ different (if different, explain below)
8. If the proposed substitution is accepted, it will result in:
   ✓ no cost impact  ☐ a cost increase of  
   ☐ a cost decrease of
   (If change in cost is indicated, itemization or specified Cost Itemization Form is attached)

9. License fees or royalties are pending on the proposed substitute.
   ✓ No  ☐ Yes (if yes, explain below)

10. The undersigned or the firm represented shall pay for additional studies, investigations, submittals, redesign, and analysis by the Designer necessitated by this substitution request.

Submitted by:
   Name: Jerry D. McKennon
   for: Appalachian Commercial Products
   Address: 226 Birch Street
   Telephone: 923-323-2952
   Date: 10/11/2016

Designer's Review Comments:
   ✓ Accepted  ☐ Accepted as noted  ☐ Rejected  ☐ Rejected (received too late)  ☐ Rejected (submittal incomplete)

Additional comments: Submittals will be required prior to construction

For the Designer:
   Signature here: Patricia R. Cook
   Date: 10/17/16
FLUSH DOORS

Eggers' 5-ply flush doors are the very embodiment of form marrying function - extraordinary beauty and exceptional durability. We are able to produce a variety of custom architectural designs to suit all styles and needs.
5-PLY FLUSH DOORS

Eggers employs the highest level of artistic craftsmanship alongside hot press technology and bonded cores to produce the most elegant, high-performing doors. Our 5-ply flush doors can be specified to your needs - lead-lined, bullet-resistant, acoustical, impact-resistant, non-rated and fire-rated through 90-minute.

Let Eggers' unique offerings set your project apart. Create a stunning first impression by utilizing our precise sketch face capabilities; add to the beauty of your project by using our striking Vinterio veneer face option; or create a streamlined modern design by specifying our beadless lite flush door on your next project.

Whatever the impression you want to make, the combination of your creativity and Eggers' craftsmanship will bring your vision to reality.
Soundwood Acoustical Capabilities

Eggers' acoustical doors have the highest STC ratings in the industry. Our capabilities allow you to combine the privacy of acoustical performance with other special functionality to meet the design requirements and building codes for your project. Eggers' offerings include, but are not limited to:

- Acoustical designs with fire ratings up to 90-minute.
- STC ratings up to 52 for flush doors.
- STC ratings up to 40 for stile & rail doors.
- Veneer, MDO, vinyl or plastic laminate faces.
- A variety of gasket system options with or without raised thresholds and automatic door bottoms.
- Complete gasket system and installation instructions provided with STC doors.
- Combined STC and LEED®/FSC® certified offerings.
- Some STC ratings also provide x-ray shielding.

Lead-Shielded Doors

Our lead-shielded doors are ideal for use in x-ray rooms and radiation treatment facilities. Manufactured under strict quality control, Eggers' lead-shielded doors provide the highest radiation protection.

- Standard offerings in 1/32", 1/16" or 1/8" total lead thickness. Higher thicknesses per engineering review.
- Balanced at one half total thickness per side.
- Available in 20-, 45- and 60-minute fire ratings.
- Lite cutouts and factory glazing available.
- Singles available up to 4' x 10' and pairs available up to 8' x 10', with a maximum individual door weight of 500 lbs.

Bullet-Resistant Doors

Eggers' bullet-resistant doors offer the aesthetic quality of wood while providing the highest rated protection available. Bullet-resistant doors help ensure safety from direct arm fire in government and other public facilities.

- Available in resistance levels 1-8, per UL 752.
- All protection ratings are eligible for a UL 20-minute fire label.
- Glazing available in doors, up to the required ballistics rating.
- Veneer, MDO or plastic laminate faces.

For our complete Soundwood Acoustical Capabilities, please visit www.eggersindustries.com and click on technical data.
<table>
<thead>
<tr>
<th><strong>Max. Door Size</strong></th>
<th>20-Minute Single</th>
<th>20-Minute Rated</th>
<th>30-Minute Rated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Size</td>
<td>4' x 10'</td>
<td>8' x 10' parallel and dbl. oglass</td>
<td>4' x 10' (per leaf)</td>
</tr>
<tr>
<td>Thickness</td>
<td>1-3/4&quot; - 2-1/4&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core</td>
<td>Particleboard, UF-free particleboard, FSC certified particleboard, stave. FSC certified stave, structural composite lumber (SCL), FSC certified structural composite lumber and agiliber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Door &amp; Transom Non-Rabbetted</td>
<td>4' x 14' (with transom bar)</td>
<td>4' x 14' (with transom bar)</td>
<td>4' x 14' with or without a transom bar or rabbetted</td>
</tr>
<tr>
<td>Stiles</td>
<td>Veneered structural composite lumber, solid lumber edges available upon request</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rails</td>
<td>No-Fail construction is standard for SCL; 1-1/8&quot; for all other core types (multiple-ply optional)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reinforcements</td>
<td>Blocking for screw attached surface hardware required for agiliber; not required for extra heavy duty applications for SCL and stave core or heavy duty applications with particleboard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faces</td>
<td>All available domestic and foreign veneers, medium density overlay (MDO), and high pressure laminates and vinyl</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crossbands</td>
<td>1/11&quot; high density fiberboard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lites</td>
<td>Up to 1299 sq. in. standard, SCL, and stave core available with 2868 sq. in. Beadless lite construction available -- requires maximum 6&quot; top rail and factory glazing. Factory glazing recommended to comply with new NFPA standards</td>
<td>Size restricted only by min. margins. Beadless lite construction available requires maximum 8&quot; top rail and factory glazing</td>
<td></td>
</tr>
<tr>
<td>Louvers</td>
<td>Metal louvers up to 576 sq. in. where allowed by code</td>
<td>Wood or metal</td>
<td></td>
</tr>
<tr>
<td>Latching Hardware</td>
<td>Cylinders, mortised, unit, or card locks; 5&quot; backset and deadbolts available</td>
<td>Most available latching hardware</td>
<td></td>
</tr>
<tr>
<td>Hinges</td>
<td>Per NFPA 80 -- butts, pocket pivots, continuous hinges; pivots (electrical options available)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flushbolts</td>
<td>N/A</td>
<td>Automatic corner or extension bolts up to 36&quot;</td>
<td>Corner or extension bolts up to 48&quot;</td>
</tr>
<tr>
<td>Fire Exit Hardware</td>
<td>Rim, surface and concealed vertical rod (full or top rod only), and fire exit hardware</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closers, Stops, Holders</td>
<td>Listed surface hardware or concealed hardware having mortise up to 23-3/4&quot; x 1-1/2&quot; x 1-3/8&quot;</td>
<td>Listed surface hardware or concealed hardware having mortise 1-3/8&quot; wide</td>
<td></td>
</tr>
<tr>
<td>Drop Seals</td>
<td>Listed and approved surface, semi-mortised or mortised</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special Details</td>
<td>Machining for hardware; installation of lites and louvers; sketch faces; applied moulding; beadless lite construction; kickplates; solid wood grillwork and divided lites; reveals; raceways</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finish</td>
<td>UV-cured, primed, painted (MDO only), sealer, top sealer, catalyzed polyurethane, and opaque varnish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warranty</td>
<td>Life of installation (interior); 3 years (SCL exterior)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standards</td>
<td>WDMA I.S. 1A, AWS Section 9 Edition 1, NFPA 252, UL 10B, UL 10C, NFPA 80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering Specifications</td>
<td>45-, 60- &amp; 90-Minute Fire Door Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Max. Size</strong></td>
<td>4' x 10'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dol. egress: 8' x 8' or 2 lvs. active 6' x 9'</td>
<td>4' x 9'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8' x 6', SVRs: 6' x 9'</td>
<td>4' x 9'</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Thickness</strong></td>
<td>1-3/4'' - 2-1/4''</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Door &amp; Transom Non-Rabbetted*</td>
<td>4' x 11'' (max. transom size 4' x 4') - doors and transoms must be separated by horizontal transom bar. Transoms over parks must be separated by vertical and horizontal transom bars.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Door &amp; Transom Rabbetted*</td>
<td>3'6&quot; x 10'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Stiles</strong></td>
<td>Veneered laminated edges, solid lumber outlay edges available upon request; category A, B, or neutral pressure.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rails</strong></td>
<td>Typical rails are 1/2'' to 3/4'' on top and 1-1/2'' on bottom, construction may include lumber, treated lumber or laminated construction as required by fire door procedures for the application and options.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reinforcements</strong></td>
<td>Optional 5'' x full core width top and bottom reinforcing, 5'' x 10'' standard lath and bolt reinforcing, or blocking as specified.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Faces</strong></td>
<td>All available domestic and foreign veneers - medium density overlays (MDO), and high pressure laminate and vinyl.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Crossbands</strong></td>
<td>Min. 1/16'' high density fiberboard.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vision Panels</strong></td>
<td>Up to 1296 sq. in. max. 36'' wide, max. 54'' high. Special construction glass can be up to 1714 sq. in. max. 36'' wide, max. 86-1/2'' high. Factory glazing recommended to comply with NFPA 80 standards.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Louvered</strong></td>
<td>Up to 24'' x 24'' (not available in doors used as means of egress)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Latching Hardware</strong></td>
<td>Cylinders, mortise, unit, or card locks, 5'' backset and deadbolts available.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hinges</strong></td>
<td>Per NFPA 80 - butts, continuous hinges, pivots (electrical options available).</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Top &amp; Bottom Rail</strong></td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Listed surface, manual extension (max. 24'') &amp; automatic bolts</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Listed surface, manual extension (max. 24'') &amp; automatic bolts</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Listed surface, extension (max. 24'') &amp; automatic bolts</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fire Exit Hardware</strong></td>
<td>Listed and approved fire exit hardware, reinforced blocking options available for screw mounting (min. #10 x 1-1/2'' sheet metal screws). No prep for surface mounted. LBR available.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Closers, Stops, Holders</strong></td>
<td>Listed surface mounted closers, concealed closers, and stops not exceeding 23-3/4'' x 1-1/2'' deep x 1-1/8'' wide.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Drop Seats</strong></td>
<td>Listed and approved.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Special Details</strong></td>
<td>Cut for lily and louver openings; install glazing and metal louvers; applied moldings per approval; stile &amp; rail sketch faces for applied moldings, wood veneer wrapped metal edges and rebates; kickplates up to 45''; solid wood grillwork; reveals up to 3/8'' wide and 3/8'' deep.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Finish</strong></td>
<td>UV-cured, primed, painted (MDO only), sealer, full sealer, catalyzed polyurethane, and opaque varnish.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Warranty</strong></td>
<td>Life of installation - not suitable for exterior installations.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Standards</strong></td>
<td>WDIMAIS, 1A, AWS Section 9 Edition 1, NFPA 252, UL 10B, UL 10C, NFPA 80.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1 Metal edges not required. 2 Full or partial height metal edges and/or straps are optional with surface hardware or locks & flushbolts, but are not allowed with CLR hardware. 3 Spring bolts or metal stops required to secure the transom. 4 The bottom rail of rabbeted horizontal doors must be edge glued. 5 Minimum margins from opening; 6-10'' to base edges adjacent to openings, 1-10'' to first prep & lists over 100 sq. in. require fire-resistant glazing to maintain temperature test rating. 7 Veneer usage is required for metal vision panels. 8 Doors will be manufactured and labeled in accordance with procedures and product approval established by and through Essex Industries and Madrock Hersey or Underwriters Laboratories. 9 Minimum 10'' margin from base of door up to bottom of door are required to comply with ADA Title II for plastic linoleum face along will be painted.
Note Regarding ADA
The minimum bottom rail dimensions below are based on fire and/or warranty requirements. It is the specifier's responsibility to determine the code requirements of his/her application. Where ADA compliance is required, doors must be ordered with 10" bottom rails.

Removable True-Divided Lite Grillwork
Removable true-divided lite grillwork is an innovative offering from Eggors Industries. It's a cost effective and practical alternative to traditional true-divided lites. The grillwork provides a high-end appearance without the need for high maintenance. It easily snaps in and out of door lite openings for effortless cleaning.
- Glass is held permanently in place with our standard lite bead.
- Minimum visible glass in each lite opening is 100 sq. in. with minimum dimension of 10" x 10".
- Grillwork is not available in curved profile or layout.
- Grillwork is suitable only with 1/4" glass.
- Interior use only, not available for exterior doors.
- Not available in fire-rated doors.
- Grillwork will be the same specie as the lite beads.
- Maximum lite size 80" high x 40" wide.

Non-Rated Full-Lite Doors
- 1-1/2" minimum between lock and lite cutout.
- 3" minimum between multiple lite cutouts
- True-divided lites available.
- Grillwork available to achieve aesthetics of a French door.
- 5-ply construction, SCL or stave core.
- Stiles bonded to core and sanded as a single unit.
- Standard edge strip is minimum 1" veneered SCL, solid lumber cutout edge available upon request
- Glass can be factory glazed or field glazed with glass type specified.
- 5" minimum stiles and rails to meet warranty requirement.
- Beadless lite construction available

20-Minute Full-Lite Doors
- 20-minute door utilizes clear glass that is fire- and safety-rated.
- 20-minute fire rating with visible lite up to 2,868 sq. in. (87-9/16" maximum height x 36" maximum width).
- 1-1/2" minimum between lock and lite cutout.
- 3" minimum between multiple lite cutouts.
- Factory glazing recommended on fire rated doors to comply with new NFPA standards.
- True-divided lites available - maximum cutout of 35-7/8" wide by 89-5/8" high (various layouts available/maximum dimension of a single pane of glass is 54").
- Solid wood grillwork available to achieve aesthetics of a French door.
- 5" minimum stiles and rails.
- 5-ply construction, SCL or stave core.
- Sides bonded to core and sanded as a single unit.
- Standard edge strip is minimum 1" veneered SCL, solid lumber cutout edge available upon request
- Glass to be safety- and fire-rated.
- Beadless lite construction available

45-Minute Full-Lite Doors
- 45-minute fire rating with visible lite up to 1,714 sq. in. using Firelite Plus (86-1/2" maximum height x 36" maximum width).
- 3" minimum between lock and lite cutout.
- 6" minimum between multiple lite cutouts.
- Solid wood grillwork available to achieve aesthetics of a French door.
- 6" minimum top rails and side stiles. 10" minimum bottom rail.
- Reinforced face construction.
- Stiles bonded to mineral core and sanded as a single unit.
Balance Match
- Each panel face is assembled from veneer leaves of uniform width before edge trimming.
- Panels may contain an even or odd number of leaves and distribution may change from panel to panel within a sequence set.

Center Match
- Each panel face is assembled of an even number of veneer leaves of uniform width before edge trimming.
- There is a veneer joint in the center of the panel producing horizontal symmetry.

Running Match
- Each panel face is assembled from as many veneer leaves as necessary.
- Results in a non-symmetrical appearance with some veneer leaves of unequal width.
- Often the most economical method at the expense of aesthetics.

Book Match
- Veneer joints match, creating a symmetrical pattern. Yields maximum continuity of grain.
- Prominent characteristics will ascend or descend across the match.
- Because right side and loose side faces alternate in adjacent leaves, they reflect light and accept stain differently and this may yield a noticeable color variation, termed "Barber Pole." Barber Pole is not considered a defect.
- This effect may be minimized through the use of proper finishing techniques.

Slip Match
- Adjoining leaves are slipped out in sequence with all the same-face sides being exposed.
- The joint may not be noticeable if grain is straight.
- Figure repeats but grain does not match at joints.
- Produces a uniform color because all faces have a similar light reflection.
- A leaning effect may occur if the species used does not demonstrate a straight grain.

Diamond Match

Sunburst

For additional information, please refer to AWS Quality Standards Edition 1, Section 4.
## DURATION OF WARRANTIES

<table>
<thead>
<tr>
<th>DOOR TYPE</th>
<th>INTERIOR USE</th>
<th>EXTERIOR USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle, Agrifiber</td>
<td>Life of original installation</td>
<td>Not warranted</td>
</tr>
<tr>
<td>SCL</td>
<td>Life of original installation</td>
<td>Three years from date of original installation</td>
</tr>
<tr>
<td>Slave</td>
<td>Life of original installation</td>
<td>Not warranted</td>
</tr>
<tr>
<td>Plastic</td>
<td>Life of original installation</td>
<td>Not warranted</td>
</tr>
<tr>
<td>Mineral Core</td>
<td>Life of original installation</td>
<td>Not warranted</td>
</tr>
<tr>
<td>Acoustical</td>
<td>Life of original installation</td>
<td>Not warranted</td>
</tr>
<tr>
<td>Acoustical Airport - Flush</td>
<td>Life of original installation</td>
<td>Five years from date of original installation</td>
</tr>
<tr>
<td>Lead Shielded</td>
<td>Life of original installation</td>
<td>Not warranted</td>
</tr>
<tr>
<td>Stile &amp; Rail - Non-Rated</td>
<td>Life of original installation</td>
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All doors manufactured by EGGRESS INDUSTRIES of Neenah, Wisconsin and EGGRESS INDUSTRIES of Two Rivers, Wisconsin (hereinafter referred to as Eggers) are warranted to be free from defects in material and workmanship which would render them unserviceable or unfit for the ordinary, recommended use, for the time periods as set forth below. This warranty automatically applies to purchasers of doors from Eggers and extends on resale of the product. Claims should be processed through the intermediate suppliers. It is the responsibility of Eggers' intermediate suppliers to make the initial jobsite visit on a complaint to verify the issue and collect necessary documentation (i.e., sizes, pictures, etc.). On occasion, it may be necessary for Eggers to send a representative to the jobsite. If an Eggers representative is required to go to the jobsite and the issue is determined not to be a manufacturer's issue, then the intermediate supplier will be charged for all applicable expenses related to the jobsite visit.

**LIMITATIONS OF LIABILITY**

Eggers shall not be liable for incidental, indirect or consequential damages arising from the manufacture, use or sale of these goods. (This warranty gives you specific legal rights, and you may also have other rights that vary from state to state.) Eggers' liability is expressly limited to the repair or replacement of non-conforming goods or the refund of the purchase price, at the option of Eggers.

If any door becomes defective after installation, Eggers agrees to bear the reasonable expense of repairs, rework, machining, finishing, removing and rehanging such repairs. Rework, removal and rehanging shall be performed only after approval is obtained from Eggers and the cost of such work has been determined. In the event the defect for which the doors are being rejected was apparent prior to hanging, Eggers is not obligated to pay removal and rehanging charges.

**NOTICE REQUIREMENT**

Since Eggers cannot control the handling or exposure of doors after shipment, a specific duty of inspection is imposed upon the purchaser as a condition precedent to any claim under this warranty. Such inspection must be made upon receipt of the goods and written notice of any claim must be received by Eggers within 30 days of receipt of the goods, or discovery of the defect. NO CLAIM UNDER THIS WARRANTY SHALL BE ACTIONABLE UNLESS THE FOREGOING NOTICE IS GIVEN AS SET FORTH HEREIN.

It shall not be the policy of Eggers Industries to inspect finished installations for the sole purpose of certifying that the installation is within warranty.

**MATTERS EXCLUDED FROM THIS WARRANTY**
Since methods and conditions of installation and use are beyond the control of Eggers, this warranty is not effective unless the doors are stored, handled, finished, used and installed in strict accordance with the provisions set in the following guidelines of this warranty.

Eggers Door Warranty
Tolerances, Exclusions and Instructions

TOLERANCES
1. Stile, rail and core show-through (telegraphing) shall not be considered a defect unless the foco of the door varies from a true plane in excess of 1/100" (.010") in any 3" span.
2. Warp shall not be considered a defect unless it exceeds 1/4" in the plane of the door itself. For doors 1-3/4" or thicker, warp shall not exceed 1/4" in doors 3-1/2" x 7" or smaller, nor shall it exceed 1/4" in any 3" x 7" section of larger doors. For doors less than 1-3/4" thick, warp shall not exceed 1/16" in doors 3-1/2" x 7" or smaller. Any distortion in the door itself and does not refer to the relationship of the door to the frame, jambs, or adjacent doors. Warp is measured by placing a straight edge on the concave face and determining the maximum distance from straight edge to door face.
3. Tolerances for all applied moulding locations are ± 1/8" reference to all margins.

HANDLING, FINISHING AND INSTALLATION INSTRUCTIONS
1. Store doors flat on a level surface in a dry, well-ventilated building. Protect doors with an opaque covering that does not permit light to penetrate to keep the doors clean and avoid discoloration. Covering must allow air circulation. If doors are to be stored more than a week, all edges should be sealed. Deliver doors or frames to building site after HVAC system is operating and balanced and plaster or cement is dry.
2. Doors should not be subjected to extreme heat and/or humidity. Relative humidity should not be less than 25% or greater than 55% and temperatures should not be less than 50 degrees F or greater than 90 degrees F.
3. Handle with clean gloves and do not drag doors across one another or across other surfaces.
4. The utility or structural strength of the doors must not be impaired in the fitting of the door, the application of hardware or cutting and altering for doors, louvers, panels or any other special details.
5. Use three hinges for doors 74" in height or less, and one additional hinge for each increment of 30" of height over 74".
6. Allow a fitting clearance of 1/16" to 1/8" at each side and at the top.
7. Seal all edges immediately after field fitting.
8. Prior to field applied finishes, doors must be sanded. The finisher should thoroughly sand the doors with 150-grit sandpaper going with the grain direction of the veneer. A hand block should be used to remove all scuffs, handling marks, scratches, raised grain, blemishes and effects of exposure to moisture that may occur during handling, unloading and storage.
9. Some woods, particularly Oak, contain chemicals which react with iron. Do not use steel wool on Oak doors.
10. Doors finished at the factory should be checked against approved finish sample prior to hanging. (Installation of finished doors shall constitute acceptance.)
11. Stiles and rail doors not prefinished at the factory must be stained and sealed, or painted, within 10 working days after the doors arrive from Eggers. Stiles and rail doors supplied to Hawaii or Alaska must be factory finished.
12. Pilot holes must be drilled for all screws that act as hardware attachments. Self-tapping or combination woodscrew screws are not warranted for use on wood doors.

EXCLUSIONS
This warranty does not cover:
1. The appearance of field finished doors.
2. Natural variations in the color, texture, character, or cut of the wood.
3. Doors with cutouts closer than 5" to the door edge or doors with adjacent cutouts such as hardware, lites, louvers, etc. closer than stated minimums.
4. Doors which have cutout areas exceeding 54" in door height. However, waivers in writing from the factory are available on a per job basis. This exclusion is waived on special full lite construction warranted for life of original installation for interior use.
5. Doors that are improperly hung and door frames that are not plumb, square and level and do not allow the door to swing freely.
6. Warpage of doors less than 1-3/4" thick which are wider than 30" or higher than 74".
7. Normal wear and tear including wear-through of finish.
8. Doors supplied outside the United States for telegraphing or warpage unless approved by the factory.
9. Cracking of plastic laminated surfaced doors with openings cut by other than Eggers or its authorized representative. Radius of 1/4" at corners of openings must be maintained.
10. Incompatibility of hardware with a particular door construction. This includes mortises such as concealed closers, magnetic holders, etc. deeper than 2" or wider than 1-1/4" and concealed vertical rod devices, unless speeded reinforced construction is ordered.
11. Constructions involving different species, face materials, or veneer grain configurations on opposite sides of the door. This includes doors with different plastic colors or patterns on each face. This may create an unbalanced condition not warranted against warpage, cracking, delaminations, etc. Exclusion may be waived for SCL core flush doors or stile and rail doors with proper approval in the form of a letter from manufacturing.
12. Constructions, other than flush SCL, involving appliques (excluding applied moulding) that are applied to only one face of the door.
13. Doors that are not stored as outlined in the Handling, Finishing and Installation Instructions.
14. Doors that are stored longer than six months.
15. OEM's warranty applies to all accessories supplied by Eggers.
16. Doors that have any form of fast growing which penetrate the crossbanding in excess of limitations set by the factory.
17. Doors altered by others for size by re-railing or re-stilling or relacing or defects resulting from other machining or alterations performed by others.
18. Stylus molding on one side of the door. Applied molding on one side of the door if molding is over 1-3/4" wide, 3/4" high or over 24 linear feet. Miter joints and flatness on moldings over 3" in width.
19. Doors up to 7'6" in height with less than three hinges and doors with less than one additional hinge for each incremental 30" of height over 7'6". This exclusion is waived on non-rated particle, aggluiber, or stave core up to 8'0", stile & rail doors up to 8'0" and QC core doors up to 9'0" when installed with top and bottom pivot hardware.
20. Doors machined for corner primed flush bolts unless installed with metal edges or flush bolt cap.
22. Lites not glazed by Eggers, including glass breakage and damage to the door.

NOTE: Action on any claim for warp or telegraphing defects may be deferred at the option of the manufacturer for a period not to exceed 12 months to permit conditioning of the doors to temperature and humidity conditions.

EXTERIOR FLUSH AND STILE AND RAIL DOOR GUIDELINES

An exterior door is defined as one that cannot be controlled on both sides for temperature and humidity.

When exterior doors are machined for hardware or a lite opening, opportunity exists for moisture penetration into the door which will eventually cause deterioration. Therefore, the existence of the following conditions will void the warranty for exterior installations:
1. Doors installed outside the continental 48 states.
2. Failure to double seal all machined surfaces including openings and hardware cuts with exterior sealant.
3. Failure to properly protect lite cutouts in exterior doors to prevent moisture from seeping into the core. Lip moldings and exterior caulking are required. The top of an exterior door must be properly protected by flashing (except STC doors for airport housing).
4. Failure to provide adequate overhead protection. Adequate overhead protection includes a minimum of 4 ft. between the top of the door and the bottom of the overhead. A minimum overhead protection of 4 ft. out from the face of the door and a minimum protection extension of 4 ft. out from each side of the door.
5. Failure to provide the entire door including top and bottom edges with two coats of a good quality paint, varnish or lacquer.
6. This warranty does not cover telegraphing and checking of exterior doors.

Additional Exterior Guidelines
1. Eggers will not quote the Stylus door for an exterior application.
2. Eggers will not quote exterior doors with concealed hardware (vertical rods, flush bolts and closers/holders/stops).
3. Eggers will not quote exterior doors with machining for pivots and magnetic latches in the top rail of the door.
4. Eggers will not quote exterior doors with louvers.
5. The 20-minute door will be quoted for exterior applications, but no lite cutouts will be allowed.
6. Eggers will quote 45, 60 and 90-minute flush doors for exterior application.
7. Eggers will not quote doors for applications with applied molding and reveals.

Exterior finishes should be used on the exterior faces and all edges of exterior doors. A complete and continuous finish must be maintained on all surfaces of the door and must be refinished annually.

Airport Housing Projects
STC doors have been approved for residences around airports in Southern California and the Southwest with a five-year warranty. Contact the factory regarding exterior STC door requirements for airport housing projects in other locations. Top flashing not required on STC doors.

It should be noted that both the WDMA and AWI Standards indicate that wood doors are not recommended for exterior use.
addendum #04

project: ETSU IPER Center (Building 60 Renovation)
   rca 13-024    SBC 166/005-06-2013

to: Nick Self – BurWil Construction, CM/GC

from: Patrick Core – Red Chair Architects
   220 W. Jackson Avenue
   Knoxville, TN 37902

date: 10/21/2016

This Addendum forms a part of the Contract Documents and modifies the original Bidding Documents dated 06/24/16 as noted below. All such modifications, amendments, and/or supplements shall be considered as through originally specified and/or shown on the Drawings or in the Specifications. This Addendum shall be acknowledged on the Bid Form. Failure to do so may subject Bidder to disqualification. All parties receiving this document are responsible for reviewing all items included in this Addendum regardless of headings as listed herein.

This Addendum consists of Two (2) pages and the attached Drawings and Specifications as listed below. Refer to bubbled areas on attached Drawing sheets for changes.

attachments:
1. FSC Addendum #4 dated 10/21/16 (2 pages - 8-1/2" x 11")
2. Revised specifications (49 pages - 8-1/2" x 11")
3. Revised drawings (5 pages - 24" x 36")

changes to prior Addenda:
4. None

changes to Bidding Requirements:
5. None

changes to Agreement:
6. None

changes to Conditions of the Contract:
7. None

changes to Specifications:
8. Section 00 01 10 R4 – Table of Contents: Refer to highlighted areas for revised specification sections.
9. Section 06 41 16 R2 – Plastic Laminate Faced Architectural Cabinets – Updated section
10. Section 06 48 00 R1 – Wood Frames – Updated section
11. Section 08 14 16 R2 – Flush Wood Doors – Updated section
12. Section 08 91 19 R3 – Fixed Louvers – Refer to Part 2.3, A, 4, a. Revise as follows:
   1. Free Area: Not less than 7.2 sq. feet for 48-inch-wide by 48-inch-high louver.
13. Section 09 51 23 R2 – Acoustical Tile Ceilings – Updated section
14. Section 10 14 00 R1 – Exterior Accessible Directional Signage – New section
15. Refer to FSC Addendum #4 for further information.
changes to Drawings:
17. Sheet C102 R3 – Backflow preventer and RPZ removed.
18. Sheet C201 R3 – Backflow preventer and RPZ removed, detail 16.
19. Sheet A120, A121, A122, A123 - revise note #4 to read:
   4. ALL A.C.T. CLOUDS SHALL HAVE METAL EDGE TRIM BY A.C.T. MFR. -
      REFER TO 09 51 23
22. Sheet A823 R2 – revise note at acoustical tile ceiling to read:
      "2" STEEL CHANNEL MOLDING ACT TRIM"
23. Refer to FSC Addendum #4 for further information.

clarifications:
24. Sheet AV103 shows an incorrect date. The correct date for this sheet is 08/11/16.
25. Sheet AV.A1 shows an incorrect date. The correct date for this sheet is 08/11/16.
26. Sheet AV.V1 shows an incorrect date. The correct date for this sheet is 08/11/16
27. AWI quality certification is not required for woodworking companies for this project. However,
    AWI's referenced standards shall be followed.

end of addendum
addendum #05

project: ETSU IPER Center (Building 60 Renovation) 
rca 13-024 SBC 166/005-06-2013

to: Nick Self – BurWil Construction, CM/GC

from: Lisa Hoskins – Red Chair Architects
220 W. Jackson Avenue
Knoxville, TN 37902

date: 11/8/2016

This Addendum forms a part of the Contract Documents and modifies the original Bidding Documents dated 06/24/16 as noted below. All such modifications, amendments, and/or supplements shall be considered as through originally specified and/or shown on the Drawings or in the Specifications. This Addendum shall be acknowledged on the Bid Form. Failure to do so may subject Bidder to disqualification. All parties receiving this document are responsible for reviewing all items included in this Addendum regardless of headings as listed herein.

This Addendum consists of Two (2) pages and the attached Drawings and Specifications as listed below. Refer to bubbled areas on attached Drawing sheets for changes.

attachments:
1. FSC Addendum #5 dated 11/8/2016 (1 page – 8 ½ x 11)
2. Revised Specifications (15 pages – 8 ½ x 11)
3. Revised Drawings (9 pages – 24x36)

changes to prior Addenda:
4. None

changes to Bidding Requirements:
5. None

changes to Agreement:
6. None

changes to Conditions of the Contract:
7. None

changes to Specifications:
8. Section 00 01 10 – Table of Contents: Refer to highlighted areas for revised specification sections (6 pages)
9. Section 06 20 13 – Exterior Finish Carpentry – See revision 2 which allows cellular PVC trim. (9 pages)
10. Section 01 23 00 – Alternate 1 is accepted for construction and integrated into the base price. This section shall be modified as follows: The words “alternate #1” shall be changed to “base price”.

changes to Drawings:
12. Sheet P100 – R2 – Vent piping revised.
13. **Sheet P101** – R2 – Vent piping revised.
14. **Sheet P102** – R2 – Vent piping revised.
15. **Sheet P103** – R2 – Vent piping revised.
16. **Sheet P200** – R2 – Valves revised.
17. **Sheet P201** – R2 – Valves revised.
18. **Sheet P202** – R2 – Valves revised.
19. **Sheet P203** – R2 – Valves revised.

clarifications:
20. Alternate 1 is accepted for construction and is now included in the base price. Construction shall incorporate the design indicated as “alternate 1” on sheet E003 for Details 2&4 (in lieu of 1& 3) and Sheet ES100 for Note 2 (in lieu of 1).

end of addendum
addendum #06

project: ETSU IPER Center (Building 60 Renovation)  
eca 13-024  SBC 166/005-06-2013

to: Nick Self – BurWil Construction, CM/GC

from: Lisa Hoskins – Red Chair Architects  
220 W. Jackson Avenue  
Knoxville, TN 37902

date: 11/14/2016

This Addendum forms a part of the Contract Documents and modifies the original Bidding Documents dated 06/24/16 as noted below. All such modifications, amendments, and/or supplements shall be considered as through originally specified and/or shown on the Drawings or in the Specifications. This Addendum shall be acknowledged on the Bid Form. Failure to do so may subject Bidder to disqualification. All parties receiving this document are responsible for reviewing all items included in this Addendum regardless of headings as listed herein.

This Addendum consists of One (1) page and the attached Drawings and Specifications as listed below. Refer to bubbled areas on attached Drawing sheets for changes.

attachments:
1. None

changes to prior Addenda:
2. None

changes to Bidding Requirements:
3. None

changes to Agreement:
4. None

changes to Conditions of the Contract:
5. None

changes to Specifications:
7. Section 07 50 35 – Roof Warranty Execution – Item 3.02 B: Replace “thirty (30)” with “twenty (20)”.
8. Section 07 50 36 – Roof Warranty – Item 16 shall be modified as follows: Delete “For a 30 year single ply membrane roof system” and replace with “For a 20 year cold fluid applied waterproofing plaza roof system”.

changes to Drawings:
9. Sheets A112-A115 – Floor assemblies FC-8 and FC-8 (NC) shall not include layers of gypsum board or resilient hangers on the underside of the deck assembly. Delete those items where shown for FC-8 and FC-8 (NC) on: “horizontal assembly schedule” on sheet A112, and the following details: 1/A112, 2/A112, 1/A113, and 3/A115.

clarifications:
10. None

end of addendum
SECTION 00 00 02 – PROJECT DIRECTORY

Owner: Tennessee Board of Regents
East Tennessee State University
Facilities Management
PO Box 70653
Johnson City, TN 37614
V 423.439.7900

Architect: Red Chair Architects
220 W. Jackson Avenue
Knoxville, TN 37902
V 865.633.9058

Civil: Tysinger, Hampton & Partners, Inc.
3428 Bristol Highway
Johnson City, TN 37601
V 423.282.2687

Structural: Bender & Associates
110 Forest Court
Knoxville, TN 37919
V 865.584.6532

Fire Protection, Plumbing, Mechanical, and Electrical: Facility Systems Consultants, LLC
713 South Central Street, Suite 101
Knoxville, TN 37902
V 865.246.0164

Environmental: Quantum Environmental & Engineering Services LLC
126 Dante Road
Knoxville, TN 37938
V 865.689.1395

END OF SECTION 00 00 02

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**DIVISION 23 HVAC & PIPING**

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33 50 00 Temporary Bypass Pumping ............................................................................................................................. 4
33 40 00 Storm Drainage Systems .................................................................................................................................. 5
33 30 00 Sanitary Sewerage Systems ........................................................................................................................... 15

The following Sections were deleted:
00 01 15 - List of Drawings
01 21 13 - TBR Allowances
01 21 15 - TBR List of Allowances
04 01 20 - Brick Masonry Repair and Repointing

END OF SECTION 00 01 10
REQUEST FOR GMP

For Project: ETSU INTERPROFESSIONAL EDUCATION AND RESEARCH CENTER (BUILDING 60)

A. A Guaranteed Maximum Price (GMP) is requested for the Work described in this Project Manual and the associated drawings and addenda. You are to obtain bids for trade subcontracts, and develop the proposal GMP in accordance with the CM/GC Master Contract.

B. The GMP shall be for:
   - [x] a new Contract.
   - [ ] an amendment to an existing Contract.

C. The GMP shall offer alternates as specified. In addition, voluntary alternates:
   - [x] may be proposed, up to 3 in number.
   - [ ] may not be proposed.

D. Contract Bond, in the amount of 100% of the Contract Sum, on the Owners standard form is required. If this proposal is for an amendment, a rider to the existing bond acknowledging the amendment and the revised Contract Sum is required. A Three-Year Roof Bond is:
   - [x] required, for
     1. Horizontal/plaza deck assembly waterproofing & topping – $80,000
     2. Areas of roof repair and replacement indicated on drawings (membrane and slate roof areas) -- $50,000
   - [ ] not required.

E. Substantial completion of this Work shall be achieved in the number of calendar days Contract Time allotted each Phase below, from and including the Commencement of each, and accepting the conditions for Liquidated Damages, per day, in the amount set forth for each, wholly and severally for each Phase:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Commencement</th>
<th>Contract Time</th>
<th>Liquidated Damages</th>
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<tr>
<td>All</td>
<td>Notice to Proceed for all Work</td>
<td>548 days</td>
<td>$500</td>
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</table>

END OF SECTION
INSTRUCTIONS TO CM/GC FOR PRODUCING THE GMP

A. Subcontractors that have been disqualified from participating in State Building Commission projects may not be recommended for any part of this Work, and shall not be allowed to perform any part of this Work. The CM/GC and its subcontractors shall not knowingly utilize the services of an illegal immigrant in the performance of this Work, and shall not knowingly utilize the services of any subcontractor, sub-subcontractor, or consultant who utilizes the services of an illegal immigrant in the performance of this Work.

B. The CM/GC shall present the GMP with an acknowledgement of all addenda.

C. If the GMP includes work of a subcontract trade regulated by state licensing laws, the CM/GC shall identify the subcontractor’s license information called for by licensing law.

D. The CM/GC shall provide the following information explaining the derivation of costs:

1. Standard forms provided for documenting the GMP are recommended for the convenience of the Owner, to provide the CM/GC with a basic format most easily evaluated and accepted by the Owner. These forms are reproduced in this project manual, and are available as Excel spreadsheets in the Designers’ Manual posted on the Owner’s website. Standard forms include:
   - Section 00 42 23 GMP Summary
   - Section 00 42 71 GMP List of Trade Subcontracts
   - Section 00 42 75 GMP Disclosure of General Conditions
   - Section 01 26 55 Form for Price of Work

2. Provide a Cumulative Summary when adding scope or phases to an existing GMP Contract, and show the history of the current GMP, and the effect of the amending the new GMP to the existing GMP. No standard form is provided, but a format similar to the GMP Summary is preferred.

3. GMP Summary shall show the cost elements of trade subcontracts, general conditions, self-performance, CM/GC contingency, fee, and a total of these, with percentages for self-performance, contingency, and fee. If alternates are required and/or volunteered, these shall be shown distinct from the cost of the base work, and the cost elements named above provided for each. The standard form accommodates this information as if there are three required and three volunteered alternates; however, it is not intended to infer a required number of alternates for a particular project. The Owner normally expects quality pre-construction services to produce no alternates.

4. GMP List of Trade Subcontracts shall show hard bids distinct from allowances and estimates. If there are alternates, these shall be shown distinct from the cost of the base work, similar to the GMP Summary. The standard form accommodates this information. List only those allowances that are specified. If an allowance is part of a trade subcontract, show the allowance portion as an allowance, and show the remainder of the trade in the Estimates or Hard Bids, as applicable. Trades may only be so designated to the extent that they are being procured through bidding, either before or after the GMP agreement or amendment, in accordance with the Master Contract. Portions of the Work that the CM/GC will procure through direct purchase without bidding cannot be Trades, and must be a part of Self-Performance. An exception to the requirement of bidding a trade can be in accordance with specification section 01 29 16 paragraph 1.03.F.

5. Bid Tabulation of Trade Subcontracts shall show the various trade bids in a manner that facilitates easy comparison and determination of the low bidder, with notations explaining post-bid adjustments and rejections. Copies of the bids shall also be provided, to allow the Designer and Owner the opportunity to correlate the Bid Tabulation to the bids. No standard format is provided.
6. The Self-Performance portion of the GMP shall be itemized using the Form for Price of Work, showing the costs, overhead, and profit in a manner similar to that required for change order price itemization. The standard form accommodates this information.

7. GMP Disclosure of General Conditions shall list the line items included in the original proposal by which the CM/GC was selected, and the comparable costs included in the specific GMP being presented, identifying and explaining deviations. The standard form accommodates this information based on commonly used line items, but is not necessarily all-inclusive of line items applicable in this instance.

E. The proposal is to be submitted to the Owner and copied simultaneously to the Designer.

F. Once submitted, the proposal must be firm for thirty (30) days for the Owner to evaluate and complete the award or amendment, including five (5) days allowed for the proposer to sign and return award or amendment documents, once provided by the Owner, plus all required bonds and insurance documents.

END OF SECTION
1.1 EXISTING BUILDING/SITE ACCESS
   1. Access to the existing building is available to prospective bidders by appointment. Contact the following personnel at ETSU to make arrangements for site visits:
      a. Sidney Smith (423) 439-8782 smiths@mail.etsu.edu
DOCUMENT 00 31 19 - EXISTING CONDITIONS INFORMATION

1.1 EXISTING CONDITION INFORMATION

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of the Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.

B. Existing drawings that include information on existing conditions including previous construction at Project site are available for viewing at the office of Architect.

C. Survey information that includes information on existing conditions, prepared by Littlejohn Engineering of Johnson City, TN dated 01/08/15, is available as part of Drawings.

D. Photographic documentation on existing conditions is available at the office of Architect.

E. Related Requirements:
   1. Document 00 21 19 "Instructions to GMP Proposer."
   2. Document 00 31 26 "Asbestos Survey Information Available to Bidders" for hazardous materials reports that are made available to bidders.
   3. Document 00 31 32 "Geotechnical Information Available to Bidders" for reports and soil-boring data from geotechnical investigations that are made available to bidders.
   4. Document 00 31 25 "Wood Advisory Services Condition Assessment of the Wood Timbers in the ETSU IPER Center / VA Campus Building 60" for report regarding the condition of the existing wood structural framing that is made available to bidders.

END OF DOCUMENT 00 31 19
Submitted to:
Ms. Lisa Hoskins, AIA
Red Chair Architects
220 W. Jackson Avenue
Knoxville, TN 37902

Condition Assessment of
Wood Timbers in the
Eastern Tennessee State University
IPER Center • VA Campus Building 60

July 5, 2016

WOOD ADVISORY SERVICES, INC.
PO Box 1322 • 3700 Route 44
Millbrook, NY 12545

16.117.01
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1. Scope

Wood Advisory Services, Inc. (WAS, Inc.) was retained to evaluate wooden beams, columns, and decking in the ETSU-IPER, VA Campus Building No. 60 at East Tennessee State University (ETSU). These members were to be visually evaluated for damaging agents and where deemed necessary tested with a resistograph and or core bored for laboratory analysis.

2. Inspection

On May 31 and June 1, 2016, I performed an inspection of the subject building as follows:

1. Visually evaluate all individual wood beams and columns and areas of flooring and roofing for strength reducing conditions. Note: visual grading was not part of the scope of this project.
2. Hammer test each beam and column in the building and, where necessary, perform a pick test, resistograph analysis, or take a core boring for laboratory evaluation.

3. Discussion

The ETSU-IPER Center is a two story brick structure with a full basement, a primary grid system of heavy timber beams, columns, and decking and with a rafter and decking roof system. The building was constructed around 1900 as a commissary and it is my understanding was also a firehouse at one time. Photo 1 attached in Appendix II is an overview of the exterior of the building, while Photo 2 is a general overview of a typical interior area of the structure.
At the time of my inspection, I was assisted by a minimum of two and up to six ETSU employees at any one time to move the electric lift and to rearrange stored materials so that close-up access to the members of interest was possible. The condition assessment contained the following components:

**Visual Inspection** – Each beam and column was inspected individually and the floor decking, roof decking, and rafters were evaluated as areas rather than as individual members.

**Hammering** – Each beam and column was tested by hammering. This is a technique commonly used to examine the condition of timbers. Hammering can result in some limited surface indentations, however, it is also a very effective and a simple method for locating areas of internal wood decay. For this method, hammering the exterior surface of a timber resonates a tone. Sharp tones are generally indicative of sound internal wood, whereas dull tones may be indicative of internal voids or internal degradation. The voids or deterioration may be the result of wood decay or insect attack. If areas with dull tones are located, then a resistance drill or an increment borer can be used to further investigate the timber's cross sectional characteristics.

**The Pick Test** – To perform the pick test, an ice pick is inserted below the surface of a timber at an angle and pried upward, resulting in a surface splinter. The characteristics of the splinter may be indicative of incipient wood decay. Incipient wood decay is the early stage of wood decay which is not obvious to the naked eye. Significant reductions in strength are possible during this stage of wood decay. For example, reductions in bending strength can vary from 15% to 70% in the affected areas. This technique is commonly used to further investigate a member that demonstrates visual characteristics consistent with intermediate levels of decay. Photo 3 illustrates a failed pick test where the fibers broke over top of the awl.

Decay levels in wood members can be placed into three general classifications; incipient, intermediate, and advanced. As previously described, incipient decay is an early level of decay that can only be identified microscopically. Intermediate decay is the level where there is some
visual evidence that decay might exist such as discoloration or dull surfaces. Advanced decay is a level that is readily apparent to most people where the wood is heavily discolored, soft, punky, and easily crumbles.

**Resistograph Testing** – When dictated by the visual inspection, hammering or pick testing, a resistograph analysis can be performed. The resistance drill is a specially designed drill equipped with a drill bit 12" long, and a diameter of 1/8". The drill feeds the bit into a structural element or connection and the relative resistance of the needle is plotted on chart paper. The result is a density profile chart, or resistograph, of the element or connection sampled. Regions on the chart represented by consistent wood characteristics are referred to as “consistent relative density,” or CRD. Regions on the chart represented by low or undetectable density levels may be indicative of wood decay or other biological infestation that would otherwise be undetected during an external visual inspection of an element or connection. The resistograph is not sensitive to detecting incipient wood decay. Therefore, it is the philosophy of WAS, Inc. to perform periodic microbiological analyses for documentation of the presence or absence of incipient wood decay.

**Core Boring** – When dictated by the visual inspection, hammering, pick testing, or resistograph testing, 0.2” diameter core borings are removed for laboratory analysis. The borer is a tool commonly used by arborists to evaluate the internal condition of a tree or to document the annual rings of a tree performing an evaluation for dendrochronology. We utilize this core borer to allow us to microscopically confirm or reject samples we may suspect of containing decay. After the increment core is removed, a small pencil size hole remains and is filled with a treated wood plug to keep out insects in the future. Photo 4 illustrates a core boring being performed, while Photo 5 shows the core. Microscopic analysis revealed no decay in this core.

**Inspection Results** – In general, the condition of the wood members, particularly the columns and beams in the ETSU-IPER building are in very good condition with few exceptions. Those specific exceptions are listed subsequently and are arranged by floor level and grid location. In general, only occasional members exhibited any issue of significance. For definition purposes,
cracks and splits are no more than through checks. Thus, as a single category, no excessive checking was found. Twist and sweep are factors associated with warp. They have no real bearing on structural capacity. Only one column had enough twist to consider it difficult to encase in a wall and this member will be identified. Slope-of-grain is a visual grading criteria. Since the beams and columns were painted, grading was not part of the scope for this project. However it is often possible to identify excessive slope-of-grain from seasoning checks which telegraph through the finish. Only one member was observed to contain severe slope-of-grain that would cause its rejection from a structural grade. That member will be identified. Seasoning checks were observed in many members but are of no significant consequence unless they are associated with a mechanical connection making the connection ineffective or in a column where it might result in a through check or split causing the column to be two smaller columns that might result in lateral buckling due to the P-\(\Delta\) effect. However none of this was observed. A split column still retains its cross sectional area for compression parallel-to-grain capacity. A 10 x 12 column with a split, resulting in two 6 x 10 members, still retains 120 square inches of cross sectional area to support compressive loads. In regard to beams, the process for the development of design stresses accounts for a check or split along the entire length. This is called the two beam theory and is accounted for in the development of shear values. One split the entire length of a beam in bending simply results in two smaller beams; one on top of the other.

4. Inspection Results

The items in this section are a list of all of the issues observed during my inspection of the ETSU-IPER building. Appendix I includes floor and roof plans with approximate locations of deteriorated conditions identified. The number on the plan corresponds to the sequential number on the list. The column and bay grid numbering system was adopted from plans supplied by Redchair Architects. Appendix II contains photographs of each deteriorated location.
Small chips were removed from one column and one beam for species identification. Wood species identifications are performed using a light microscope at magnifications of 100 to 400x. Thin sections are cut using a double edged razor blade from a wood sample. They are placed on microscope slides and the microscopic characteristics are examined. A dichotomous key is used to verify the wood species based on the microscopic characteristics observed. Both samples were found to be southern pine.

Only two locations in the ETSU Building were inaccessible. These locations were on Level I on the south side (building front) on both the east and west sides of the entry. These were inaccessible because the walls and ceilings were plastered.

**4.1 Roof**

1. Photo 6 – Decayed roof decking on sloped roof east of Column E between Bays 17 and 18.
2. Photos 7 & 8 – Decayed roof decking in bays extending west from eyebrow window between Column lines B & D.
3. Photos 9 & 10 – Decayed roof decking between Column lines D & E at change in roof slope between rafters 3 & 4 to the south of Column line D.
4. Photos 11 & 12 – Water stain on the roof decking two bays east of Column 6E. A pick test failed at this location.
5. Photo 13 – Decayed roof decking & rafters between Column lines G & H and Bays 5 & 6, fourth bay to the east of Bay line 5.
7. Photos 16 & 17 – Rafter ends decayed at sill plate.
4.2 Floor Level II

No deteriorated members were observed in beams or columns on this level.

9. Photo 20 – At Bay lines 8 & 11 over the elevator, a section of the beam was removed and replaced with a hollow member built-up with 1” boards. This condition exists on each level at the same location.

4.3 Floor Level I

10. Photos 21 & 22 – At Bay line 16 between B & D, advanced decay and insect attack (minimum \( \frac{1}{2} \) depth).
11. Photo 23 – Decayed ceiling boards and beam end at Bay line 18 at Column line E.
12. Photo 24 – Decayed beam at Bay line 13 between Column lines B & D.
13. Photo 25 – Advanced decay in beam end at brick wall at Bay line 11 between Column lines B & D.
14. Photo 26 – Limited advanced decay beam end at brick wall at Bay line 8 between Column lines B & D.
15. Photo 27 – Ceiling boards decayed on ends where pipe penetrates ceiling boards at Bay line 1, Column line E.

4.4 Basement

16. Photo 28 – Notch cut out of bottom of beam over pilaster at Bay line 8, Column line B against brick wall.
17. Photo 29 – 1” in 3-1/2” slope-of-grain in beam between Column lines E & G at Bay line 7.
   This is a structural reject.
18. Photo 30 – Internal void in Beam over doorway at Bay line 8 between Column lines E & G.
4.5 Flooring & Miscellaneous Issues

19. Photo 31 – A significantly twisted column on Level II (Column 12G). This is not a structural issue but may interfere with interior walls.

20. Photos 32 & 33 – Decayed flooring on Level II between Bay lines 1 & 2 and Column Lines E & F due to leaking eyebrow window.

21. Photo 34 – Occasional gouges, loose floor boards, and scattered buckled floor decking throughout building.

22. Photo 35 – Chipped out floor boards Level II between Bay lines 12 & 13 and Column lines G & H.


24. Photo 38 – General condition of heavy mold in basement.

25. Photo 39 – Significant floor sag Level I between Bay lines 1 & 2 and Column lines D & E.

5. Summary

Wood Advisory Services, Inc. was retained to evaluate the condition of the primary grid members (beams and columns), roof decking, and flooring in Building No. 60 of Eastern Tennessee State University.

A combination of visual assessments, hammer testing, pick testing, resistograph testing, and core boring were performed. The overall results indicated that the wood in this building is in quite good condition for a structure of this vintage. One beam and one column were sampled for species identification and both were found to be southern pine.

A list of 25 areas of deterioration was provided in this report. Each of these areas need some form of repair or replacement. The only area that was not accessible was on the south side of the building on Level I. These offices in the front of the building had plastered walls and ceilings and thus, no evaluation could be made at these locations.
The worst performing areas were the roof which exhibited several leaks, mostly at the intersection of changing roof slopes and at the front (south side) bump-out. These leaks need to be eliminated or decay will continue to expand at these locations.

The second area of concern is the north side of Level I near the loading dock. Several issues were observed at this location however, it is my understanding that some of this area is targeted for demolition and reconstruction.

The last general area of concern is the basement. A generally damp environment has led to some decay and general moldy conditions. This dampness needs to be eliminated.

Except for occasional individual decayed members, which were identified in the body of the report, the beam and column grid system is in an overall very good condition.

Respectfully Submitted,

Wood Advisory Services, Inc.

A.L. De Bonis, Ph.D
President/Principal Wood Scientist

ALD:kr
APPENDIX I: Building Floor Plans & Grid System
Figure 1 - Roof Plan with approximate locations of deteriorated conditions.
Figure 2 - Level 2 Floor Plan with approximate locations of deteriorated conditions.
Figure 3 - Level 1 Floor Plan with approximate locations of deteriorated conditions.
Figure 4 - Basement Floor Plan with approximate locations of deteriorated conditions.
APPENDIX II: Photographs
Photo 1 – Building overview.

Photo 2 – Typical interior.
Photo 3 – Failed pick test.

Photo 4 – Increment core being taken.
Photo 5 – Increment core.

Photo 6 – Decayed roof decking.
Photo 7 – Decayed roof decking.

Photo 8 – Close up of Photo 7.
Photo 9 – Decayed roof decking.

Photo 10 – Close up of Photo 9.
Photo 11 – Decayed roof decking.

Photo 12 – Close up of Photo 11.
Photo 13 – Decayed roof decking and rafter.

Photo 14 – Decayed rafter ends.
Photo 15 – Close up of Photo 14.

Photo 16 – Decayed rafter ends.
Photo 17 – Close up of Photo 16.

Photo 18 – Decayed rafter and roof beam.
Photo 19 – Close up of Photo 18.

Photo 20 – Hollow built up member over elevator shaft. Bay lines 8 & 11 – all floors.
Photo 21 – Decayed beam, insects also.

Photo 22 – Close up of Photo 21.
Photo 23 – Decayed ceiling boards.

Photo 24 – Decayed beam.
Photo 25 – Decayed beam end.

Photo 26 – Decayed beam end. Note peeling paint from wall likely due to water intrusion.
Photo 27 – Decayed ceiling boards.

Photo 28 – Notched beam over pilaster.
Photo 29 – Severe slope-of-grain – reject.

Photo 30 – Internal void.
Photo 31 – Twisted column.

Photo 32 – Decayed floor boards.
Photo 33 – Cause of decayed floor boards in Photo 32.

Photo 34 – Example of scattered gouges in flooring.
Photo 35 – Chipped out floor boards.

Photo 36 – Worn floor surfaces.
Photo 37 – Worn floor surfaces.

Photo 38 – Heavy mold on beams and ceiling decking.
Photo 39 – Significant floor sag.
APPENDIX III: Credentials
a) Wood Advisory Services, Inc. Company Description
Wood Advisory Services, Inc.

A wood science and engineering consulting company.

Since 1984, we have provided a wide range of consulting and testing services in virtually every aspect of wood science and wood construction technology across the United States and Internationally. Our services include: the standardized testing of wood and wood-based materials, assessment of existing wood structures and assemblies (i.e., visual grading, resistance drilling, and assessment of wood decay and/or insect attack), building envelope performance, indoor air quality investigations, failure analysis, forensic investigations, research and development, statistical reliability assessment, and witness testimony.

Wood Advisory Services, Inc. has served a variety of clients, including high profile engineering and architectural firms, major corporations, building contractors, trade associations, government agencies, building owners, insurance companies, home owners, and law firms.

Wood Advisory Services, Inc. is a consulting company specializing in the engineering uses of wood and wood-based products. Our company is composed of respected technical professionals in wood science and technology. Our experts are members of and have served as elected officers in several professional societies, including the American Society for Testing and Materials, Forest Products Society, the Society of Wood Science and Technology, the American Wood Preserver’s Association, the National Home Builder’s Association, the New York State Builder’s Association and the American Society of Civil Engineers. Our staff members have published refereed journal articles in the Forest Products Journal, Wood and Fiber Science, Journal of Structural Engineering, Transactions of the American Society of Agricultural Engineers, Journal of Materials Education, Wood Science and Technology, and Wood Design Focus. We have been pioneers in the development of full-size structural lumber testing procedures, design properties, and statistical distribution and reliability simulations. This record of professional activity and research, combined with a wealth of practical consulting experience, is brought to every project.

Wood Advisory Services, Inc.
PO Box 1322
Millbrook, NY 12545
845.677.3091
www.woodadvisory.com
**Standardized Testing**

At WAS, Inc., we have the in-house capability of performing numerous mechanical property evaluations according to the American Society of Testing and Materials (ASTM) standardized tests. Our Tinius Olsen 10,000lb bench top test machine is used for determining modulus of rupture (MOR) and modulus of elasticity (MOE), compression-parallel-to-grain, compression-perpendicular-to-grain, shear, tension-parallel-to-grain and hardness for solid wood and wood-based materials. Additionally, we have the capability of calibrating aluminum bars and proving rings used for quality control purposes.

Our in-grade full size lumber testing machine is used to evaluate lumber in bending as well as in tension. Materials from 2” x 4” x 8’ up to 2” x 10” x 16’ sizes can be evaluated. All data is recorded using a data acquisition system.

WAS, Inc. also has the capability of performing ASTM concentrated load testing of plywood panels, as well as ASTM adhesive bond characteristics.

In addition to standardized testing procedures, we have also developed non-standardized procedures that allow us to evaluate a wide range of properties for specific uses.

**Engineering & Construction**

Wood Advisory Services, Inc. has performed numerous investigations of in-situ wood structural members as well as removing large members, such as wood pile sections, for extensive mechanical and microbiological evaluations. Wood Advisory Services, Inc. provides specialized expertise in the evaluation of in-service wood piles used for foundations and marine structures.

Structural assessment and rehabilitation efforts require close examination of existing wood foundation piles. We have investigated pile condition in terrestrial, fresh water, and marine environments.

We have evaluated structural timbers, utility poles, lumber, decking, glulam, composite timbers, and structural composite panel products. Frequently, the renovation of older structures requires detailed assessment of the structural capacity of large timber beams, columns, and connections.

Failure analysis and forensic investigations of wood and wood-based products is a specialty of Wood Advisory Services, Inc. We have evaluated many types of failures such as trusses, ladders, siding, scaffolds, concrete formwork, glulam beams, heavy timbers, and a variety of built-up wooden structures. To provide the most thorough analysis for our clients, we often partner with architects, engineers, and contractors.
Building Performance

Wood Advisory Services, Inc. is frequently called upon to assess building performance problems. Many performance deficiencies in these structures are due to poor construction practices, design anomalies, moisture intrusion problems, or defective materials. These deficiencies can lead to indoor environments that promote the growth of microbiological organisms which can in turn compromise indoor air quality.

Structures & Assemblies

Wood Advisory Services, Inc. routinely evaluates performance problems in light frame wood structures. In addition to common residential and commercial light structures, we have been called upon to evaluate performance problems in very specialized applications, such as pool buildings, log homes, bowling alley’s, ice-skating rinks, timber-frame structures and gymnasiums.

Research & Development

Wood Advisory Services, Inc. has worked with industry, government agencies, trade associations, and utilities in research and development projects. We have provided the following services:

- Research project development and implementation
- Process and product evaluation
- Statistical analysis and experimental design
- International Conference of Building Officials (ICBO) code-approval assistance

Wood and wood-based products have unique mechanical, physical, and biological properties which merit consideration during the design process. Realistic material specifications often require specialized knowledge of the wood products industry and the performance history of its many and varied products. We frequently assist engineers and architects in the design of wood structures and specification of wood materials. In addition, we often advise contractors and material suppliers on the interpretation of wood construction specifications.

Expert Witness Testimony

Our technical experts have provided litigation support and expert testimony in a wide variety of legal cases. Technical rigor, objectivity, and integrity define our approach to litigation support. We have provided technical support on projects ranging from construction problems in single family dwellings to national class action product liability suits. Our experts have investigated products failures such as hardboard and other composite wood sidings, fire-retardant lumber and plywood, structural lumber, trusses, scaffold systems, ladders, partial and complete building collapses, moisture intrusion problems and a wide variety of other design and construction problems.
b) Abbreviated Personal CV of Dr. Albert L. De Bonis
CURRICULUM VITAE: ALBERT LOUIS DEBONIS
(abbreviated)

ADDRESS: Wood Advisory Services, Inc.
3700 Route 44 - Suite 102
PO Box 1322
Millbrook, NY 12545

TELEPHONE: TEL: (845) 677-3091
FAX: (845) 677-6547

M.S., Colorado State University, 1974, Wood Mechanics.
B.S., University of Massachusetts, 1972, Wood Technology.

EMPLOYMENT HISTORY:

WOOD ADVISORY SERVICES, INC.
Millbrook, New York

June 1984 - Present Position: President

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
Department of Forest Products
Blacksburg, Virginia

February 1979 - June 1984 Position: Assistant Professor

WESTERN WOOD PRODUCTS ASSOCIATION
Portland, Oregon

April 1977 - February 1979 Position: Manager, Engineering Research & Development

COLORADO STATE UNIVERSITY
Department of Wood Science
Fort Collins, Colorado

September 1972 - March 1977 Position: Graduate Research Assistant
PROFESSIONAL ORGANIZATIONS:

AMERICAN SOCIETY FOR TESTING & MATERIALS, former chairman & multiple committee responsibilities
FOREST PRODUCTS SOCIETY (Formerly Forest Products Research Society), multiple committee responsibilities
SOCIETY OF WOOD SCIENCE AND TECHNOLOGY, multiple committee responsibilities
AMERICAN SOCIETY OF CIVIL ENGINEERS, multiple committee responsibilities
AMERICAN NATIONAL STANDARDS INSTITUTE, member ANSI A14.1
NORTHEASTERN LUMBER MANUFACTURERS INSTITUTE, member, Board of Directors
NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION, associate member
NATIONAL ASSOCIATION OF HOME BUILDERS, member
NYS BUILDERS ASSOCIATION, member
SOUTHERN PINE INSPECTION BUREAU, MSR committee
SOUTHERN PINE INSPECTION BUREAU, technical committee
TRUSS PLATE INSTITUTE, associate member
NATIONAL FRAME BUILDERS ASSOCIATION, member
AMERICAN WOOD COUNCIL OF THE AMERICAN FOREST & PAPER ASSOCIATION, design professional

TECHNICAL ARTICLE AND GRANT REVIEWER - PEER REVIEW PROCESS

[Solicited by the Organizations listed below]

1. Forest Products Society
2. Society of Wood Science & Technology
3. American Society for Testing and Materials
4. USDA Cooperative State Research Service
5. USDA Competitive Grants Program
6. USDA Forest Products Laboratory
7. Massachusetts Agricultural Experiment Station

HONORS AND AWARDS

AWARD OF APPRECIATION, for Outstanding Service to ASTM (1988).
OUTSTANDING YOUNG MEN OF AMERICA AWARD (1980).
ALPHA ZETA, National Agricultural Honor Society (1972).
MAGNA CUM LAUDE, University of Massachusetts (1972).
DIRECTORY OF INTERNATIONAL BIOGRAPHY: A biographical record of contemporary achievement.

PARTICIPATION IN PROFESSIONAL WORKSHOPS – (10)

PUBLICATIONS & PRESENTATIONS:

REFEREED JOURNAL ARTICLES (11)
PROFESSIONAL JOURNAL ARTICLES (NON-REFEREED) (4)
OTHER TECHNICAL ARTICLES (205)
PROFESSIONAL PRESENTATIONS (36)
CHAPTERS IN BOOKS (1)
PROCEEDINGS ARTICLES (6)
ASBESTOS SURVEY
INFORMATION AVAILABLE TO BIDDERS

ASBESTOS INVESTIGATION AND REPORT:

A. An investigation has been performed at the project site to determine the presence and probable extent of asbestos in the existing building materials. This investigation was conducted, and a report obtained, solely for design purposes and is not a part of the Contract Documents.

B. The use and interpretation of this information is entirely the responsibility of the using party. The Owner is not responsible for variations in the actual composition of existing materials. Bidders shall decide for themselves the character of the material to be encountered.

C. The report of the findings of this investigation is on file in the Designer’s office, and may be reviewed there by any prospective Bidder of Record. Bidders must call ahead to schedule an appointment. A copy will be provided to any Bidder of Record upon request.
GEOTECHNICAL
INFORMATION AVAILABLE TO BIDDERS

SUB-SURFACE INVESTIGATION AND REPORT:

A. Sub-surface investigation has been performed at the project site. This investigation was conducted, and a report obtained, solely for design purposes and is not a part of the Contract Documents.

B. The use and interpretation of this information will be entirely the responsibility of the using party. The Owner is not responsible for variations in the sub-surface conditions. Bidders shall decide for themselves the character of the material to be encountered.

C. The report of the findings of this investigation is on file in the Designer's office, and may be reviewed there by any prospective Bidder of Record. Bidders must call ahead to schedule an appointment. A copy will be provided to any Bidder of Record upon request.
AVAILABLE INFORMATION REGARDING
OWNER’S SYSTEM OFFICE ACCESS

1.01 LOCATION

A. The Office of Facilities Development (OFD) physical and mailing address at the Tennessee Board of Regents (TBR) system office is:

Tennessee Board of Regents
Office of Facilities Development
Suite 664
Genesco Park Administration Building
1415 Murfreesboro Road
Nashville, Tennessee 37217-2833

B. The general contact phone number for TBR OFD is 615-366-4431.

1.02 ACCESS TO TBR SYSTEM OFFICE

A. Meetings related to OFD projects may occur on-site or elsewhere at the involved institution, the designer’s or contractor’s office, or the TBR system office, as befits the needs of those organizing the meeting. Public bid openings are considered meetings.

B. The Genesco Park Administration Building is in general an ADA compliant accessible building.

C. **Anyone who wishes to enter** the TBR System Office, whether to attend a meeting or deliver a bid or proposal or any other purpose, should contact one of the staff members shown below, or the staff member specifically hosting the meeting if known, and make known their intent to enter. Contact may be made in person, by writing, by email, by telephone, or otherwise, and should be received no later than 4:30pm on the third TBR business day prior to the arrival, unless specifically announced otherwise.

   For meetings related to bid or proposal solicitations and as back-up to Ms. Froggatt, either
   Rilla Froggatt
   615-366-3908
   rilla.froggatt@tbr.edu
   Cindy Potts
   615-366-4431
   cindy.potts@tbr.edu
   Tammy Ray
   615-366-4493
   tammy.ray@tbr.edu

D. **Anyone with a disability**, when making their intent to attend a meeting known, per C above, should also at that time request services needed to facilitate attendance. TBR staff responding to such requests will obtain specific information and coordinate accommodations with building management personnel, and then advise the person who made the request.

E. Persons who have made their intent to attend known as described above will normally find that building security officers will have a list of names, and will take a brief time to check them in, assign them a building visitor identification badge, and expect its return upon departure. Other persons might find that building security officers will require significant time to check with TBR and determine whether entry will be allowed.

END OF SECTION
Information Available to Bidders regarding
DISQUALIFIED CONTRACTORS and SUBCONTRACTORS

These contractors and subcontractors have been disqualified from participating in State construction projects under the supervision of the State Building Commission. Such disqualification extends to succeeding or related corporations, partnerships, joint ventures, and other business organizations having substantial factual or legal connections, continuity, or identity with those that have been disqualified. This list originates from the State Architect, and is deemed accurate as of the date of its issue. A more current list may be available.

<table>
<thead>
<tr>
<th>Disqualified</th>
<th>Name</th>
<th>last known address</th>
<th>FROM</th>
<th>THROUGH</th>
</tr>
</thead>
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There are currently no disqualifications in effect.
# GMP SUMMARY

**Project:** give SBC project number and name  
**Presented by CM/GC:** fill in name of CM/GC

<table>
<thead>
<tr>
<th></th>
<th>Date</th>
<th>Base Work</th>
<th>Specified Alternates</th>
<th>Volunteered Alternates</th>
<th>Total if all accepted</th>
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<tr>
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<td>#4 #5 #6</td>
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- **Trade Subcontracts:**
  - 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

- **Self Performance:**
  - 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

- **General Conditions:**
  - 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

- **CM/GC Contingency:**
  - 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

- **Fixed Fee:**
  - 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

- **GMP Totals:**
  - 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

- **Self-performance (% of GMP):**
- **ctgcy (% of trade, GCs, Self):**
- **fee (% of GMP):**

GMP Summary  
00 42 23 - 1
## GMP LIST OF TRADE SUBCONTRACTS

### Project:
- **Give SBC project number and name**

### Presented by CM/GC:
- **Fill in name of CM/GC**

<table>
<thead>
<tr>
<th>Date</th>
<th>Base Work</th>
<th>Specified Alternates</th>
<th>Volunteered Alternates</th>
<th>Total if all accepted</th>
</tr>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Trade allowances subtotals: 0.00 0.00 0.00 0.00 0.00 0.00 0.00

| what estimate, by whom | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| what estimate, by whom | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| what estimate, by whom | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Trade estimates subtotals: 0.00 0.00 0.00 0.00 0.00 0.00 0.00

| what hard bid, by whom | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| what hard bid, by whom | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| what hard bid, by whom | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Trade bid subtotals: 0.00 0.00 0.00 0.00 0.00 0.00 0.00

Trades totals: 0.00 0.00 0.00 0.00 0.00 0.00 0.00
### General Conditions Costs

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<td>Office Furniture &amp; Equipment</td>
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<th>Lump Sums Subtotal</th>
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</table>

<table>
<thead>
<tr>
<th>Lump Sums Subtotal</th>
<th>-</th>
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</table>

<table>
<thead>
<tr>
<th>Total</th>
<th>-</th>
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<th>-</th>
</tr>
</thead>
</table>

**Columns:**
- **Original Proposal**
- **This GMP**
- **Deviation**

Posted in XLS format

General Work for CM/GC

February 2016 OFD s004275 page 1 of 1

GMP Disclosure of General Conditions

00 42 75 - 1
STATE OF TENNESSEE
DEPARTMENT OF FINANCE AND ADMINISTRATION
ACH (AUTOMATED CLEARING HOUSE) CREDITS (Not Wire Transfers)

NAME_________________________________________________________________________________

Federal Identification Number or Social Security Number ............................................................
(under which you are doing business with the State)

I (We) hereby authorize the State of Tennessee, hereafter called the STATE, to initiate credit entries to my (our) (select type of account) _____ CHECKING or _______ SAVINGS account indicated below and the depository named below, hereinafter called DEPOSITORY, to credit the same to such account.

This authority is to remain in full force and effect until the STATE has received written notification from me (or one of us) of its termination in such time and in such manner as to afford the STATE and DEPOSITORY a reasonable opportunity to act on it.

Have you ever received payments from the State through ACH? _______ (Yes or No). If yes, do you intend for this account information to replace existing account information currently used by the State? ______ (Yes or No). If yes, please specify account that should be changed: ABA No. __________________ Account No. ____________________________. Is this authorization only for certain types of payments? ________ (Yes or No). If yes, please indicate types:
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

Many banking institutions use different numbers for ACH. Please call your bank for verification of ACH transit and account number.
Bank official contacted: _____________________________________ Phone No. _________________________

DEPOSITORY/BANK NAME _____________________________BRANCH ____________________________
CITY ____________________________________________________STATE ___________________________
ACH TRANSIT / ABA NO. _____________________________ACCOUNT NO. _________________________
NAME(S) __________________________________________________________________________________
(Please print names of authorized account signatory)

DATE _______________________SIGNED X ______________________SIGNED X _____________________

PLEASE ATTACH A VOILED CHECK (OR FOR SAVINGS ACCOUNTS, A DEPOSIT SLIP):

PLEASE INDICATE ADDRESS TO WHICH YOU WOULD LIKE YOUR REMITTANCE ADVICES ROUTED WHEN PAYMENTS ARE PROCESSED:
____________________________________________________________________________________________
____________________________________________________________________________________________
____________________________________________________________________________________________
Contact name: _____________________________________________________________________________
Telephone No.: ______________________________________________ ________________________

FOR STATE USE ONLY:
CONTACT AGENCY – ____________________________________________________________
CONTACT PERSON – __________________________________________________________
PHONE NUMBER – __________________________

FA-0825 (Rev. 4/96)
CONTRACT BOND
standard form for construction contracts under the State Building Commission of Tennessee

BOND NO. ____________________

Know all men by these presents: that we

(hereinafter called the "Principal") and

(hereinafter called the "Surety") do hereby acknowledge ourselves indebted and securely bound and held unto

(hereinafter called the "Owner"), and in the penal sum of

good and lawful money of the United States of America, for the use and benefit of those entitled thereto, for the payment of which, well and truly to be made, we bind ourselves, our heirs, our administrators, executors, successors, and assigns, jointly and severally, firmly by these presents.

But the condition of the foregoing obligation or bond is this:
Whereas, the Owner has engaged the principal for the sum of

to complete the Work of the project titled:

as more fully appears in a written agreement or contract bearing the date of

a copy of which said agreement or contract is by reference hereby made a part hereof, as fully and to the same extent as if copied at length herein, and it is the desire of the Owner that the Principal shall assure all undertakings under said agreement or contract and shall assure and protect all laborers and furnishers of material on said Work both as provided by Tennessee Code Annotated Sections 4-15-102(f)(2) and 12-4-201 through 12-4-206, and any and all amendments thereto, and shall assure the prompt payment of claims as provided by Tennessee Code Annotated Sections 12-4-207 through 12-4-208, and any and all amendments thereto. The Principal shall also comply with provisions of Tennessee Code Annotated Sections 12-4-401 through 12-4-415, and any and all amendments thereto, pertaining to the payment of the prevailing wage rate.
THREE YEAR ROOF BOND

standard form for construction contracts under the State Building Commission of Tennessee

BOND NO. ____________________

GENERAL INFORMATION:

Principal: ____________________________________________________________

Surety (Name): ________________________________________________________

(Address): ____________________________________________________________

Building Owner: _______________________________________________________

Project: _______________________________________________________________

Project Contract Date: _________________________________________________

KNOW ALL MEN BY THESE PRESENTS:

That we, the Principal and the Surety, are held and firmly bound unto the Building Owner in the amount of ______________________ for the payment thereof in good and lawful money of the United States of America the Principal and the Surety bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

Whereas, Principal has, by written agreement referenced above, entered into a contract (hereinafter referred to as "the Contract" and hereby referenced herein) with the Owner for the construction of the Project identified above.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that if the Principal shall fully indemnify the Owner for all loss that the Owner may suffer by reason of any defective material and/or workmanship in the materials furnished for and the installation of the above referenced Project roofing system which become apparent during the period of three (3) years from the date of Substantial Completion of the above referenced Project roofing system, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

Surety hereby agrees that no change, extension of time, alteration or addition to the terms of the contract or to the Work to be performed thereunder or to the specifications accompanying the same shall in any way affect the obligations under this bond, and notice is hereby waived of any such change, extension of time, alteration or addition to the terms of the contract or to the Work or to the specifications.
Now, therefore, if the Principal shall fully and faithfully perform all undertakings and obligations under the contract hereinafter referred to and shall fully indemnify and hold harmless the Owner from all costs and damage whatsoever which it may suffer by reason of any failure on the part of the Principal to do so, and shall fully reimburse and repay the Owner any and all outlay and expense which it may incur in making good any such default, and shall fully pay for all of the labor, material and work used by the Principal and any immediate or remote sub-contractor or furnisher of material under him in the performance of said contract, in lawful money of the United States, as the same shall become due, then this obligation or bond shall be null and void, otherwise to remain in full force and effect.

And for value received, it is hereby stipulated and agreed that no change, extension of time, alteration or addition to the terms of the contract or to the Work to be performed thereunder or to the specifications accompanying the same shall in any wise affect the obligation under this bond, and notice is hereby waived of any such change, extension of time, alteration or addition to the terms of the contract or to the Work or to the specifications.

In witness whereof the Principal has hereunto affixed its signature and Surety has hereunto caused to be affixed its corporate signature and seal, by its duly authorized officers, on this ______ day of __________________, 20____.

Executed in __________ counterparts.

Witness:

__________________________________________  __________________________________________
(name of Principal)                          (name of Surety)

__________________________________________  __________________________________________
(authorized signature)                      (signature of Attorney-in-fact)

__________________________________________  __________________________________________
(name of signatory)                          (name of Attorney-in-fact)

__________________________________________  __________________________________________
(title of signatory)                         (Tennessee license number of Agent or Attorney-in-fact)

__________________________________________  __________________________________________
(countersignature of resident Agent if not same as Attorney-in-fact)

Surety Company issuing bond shall be licensed to transact business in State of Tennessee by Tennessee Department of Commerce and Insurance. Bonds shall have certified and current Power-of-Attorney for the Surety's Attorney-in-Fact attached. Attorney-in-fact who executes bond on behalf of Surety shall be licensed by and a resident of State of Tennessee, and shall affix license number to bond; or, countersignature by a licensed agent who is a resident of State of Tennessee, and the agent's license number, shall be affixed to the bond in addition to the signature of the Attorney-in-Fact.
General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

Section 00 72 13 of all General Work of the Owner as of June 2009

THE OWNER:
(Name, legal status and address)

Tennessee Board of Regents

THE ARCHITECT:
(Name, legal status and address)

DESIGNER:
The Designer as identified in the Agreement

TABLE OF ARTICLES

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2 OWNER
3 CONTRACTOR
4 ARCHITECT/DESIGNER
5 SUBCONTRACTORS
6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
7 CHANGES IN THE WORK
8 TIME
9 PAYMENTS AND COMPLETION
10 PROTECTION OF PERSONS AND PROPERTY
11 INSURANCE AND BONDS
12 UNCOVERING AND CORRECTION OF WORK
13 MISCELLANEOUS PROVISIONS

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.


User Notes: Jun 09 OFD 00 72 13
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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 BASIC DEFINITIONS

§ 1.1.1 THE CONTRACT DOCUMENTS

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive or (4) a written order for a minor change in the Work issued by the Architect-Designer. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor’s bid or proposal, or portions of Addenda relating to bidding requirements.

§ 1.1.2 THE CONTRACT

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect-Designer or the Architect’s Designers’ consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect-Designer or the Architect’s Designers’ consultants or (4) between any persons or entities other than the Owner and the Contractor. The Architect-Designer shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect’s Designers’ duties.

§ 1.1.3 THE WORK

The term “Work” means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor’s obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 THE PROJECT

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by separate contractors.

§ 1.1.5 THE DRAWINGS

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.

§ 1.1.6 THE SPECIFICATIONS

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 INSTRUMENTS OF SERVICE

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect-Designer and the Architect’s Designers’ consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 INITIAL DECISION MAKER

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2 and certify termination of the Agreement under Section 14.2.2. Designer.

§ 1.1.9 PROJECT MANUAL

The Project Manual is a volume or set that may include portions of the Contract Documents and other documents.

§ 1.1.10 PROVIDE OR PROVIDED

“Provide” or “Provided” as used in Contract Documents includes furnishing and installing a thing, product, system or the like.
§ 1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS
§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.2.4 Within the Specifications, the sections of Division One (01) are General Requirements, and apply to all sections of the Specifications.

§ 1.3 CAPITALIZATION
Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 INTERPRETATION
In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE
§ 1.5.1 The Architect and the Architect’s consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, except the design and the Contract Documents, and will retain all common law, statutory and other reserved rights, including copyrights. The design and the Contract Documents are property of the State of Tennessee, and may be used again only for the benefit of the State and on authority of the State Building Commission (SBC). The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers shall not own or claim a copyright in the Instruments of Service, the design, or the Contract Documents. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Architect’s or Architect’s consultants’ reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce the Instruments of Service, the design, or the Contract Documents provided to them solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers may not use the Instruments of Service, the design, or the Contract Documents on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and the Architect’s consultants. Owner with respect to the design and the Contract Documents, and the Designer and the Designer’s consultants with respect to the Instruments of Service other than the design and the Contract Documents.

§ 1.6 TRANSMISSION OF DATA IN DIGITAL FORM
If the parties intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmissions, unless otherwise already provided in the Agreement or the Contract Documents.

ARTICLE 2 OWNER
§ 2.1 GENERAL
§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner’s approval or authorization.
Except as otherwise provided in Section 4.2.1, the Architect/Designer does not have such authority. The term "owner" means the Owner or the Owner’s authorized representative, in accordance with SBC Policy.

§ 2.1.2 The Owner shall furnish to the Contractor within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of or enforce mechanic’s lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner’s interest therein. Public construction projects are not subject to mechanic’s liens in Tennessee. The remedy afforded to laborers and furnishers of material on State projects is referenced in Section 15.2.8.

§ 2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

§ 2.2.1 Prior to commencement of the Work, the Contractor may request in writing that the Owner provide reasonable evidence that the Owner has made financial arrangements to fulfill the Owner’s obligations under the Contract. Thereafter, the Contractor may only request such evidence if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) a change in the Work materially changes the Contract Sum; or (3) the Contractor identifies in writing a reasonable concern regarding the Owner’s ability to make payment when due. The Owner shall furnish such evidence as a condition precedent to commencement or continuation of the Work or the portion of the Work affected by a material change. After the Owner furnishes the evidence, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor. The SBC project number constitutes verification that funding has been established as a matter of public record.

§ 2.2.2 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.2.3 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.2.4 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner’s control and relevant to the Contractor’s performance of the Work with reasonable promptness after receiving the Contractor’s written request for such information or services.

§ 2.2.5 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2. The Contractor will be furnished, free of charge, such copies of Contract Documents as are reasonably necessary for execution of the Work.

§ 2.3 OWNER’S RIGHT TO STOP THE WORK

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.4 OWNER’S RIGHT TO CARRY OUT THE WORK

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner’s expenses and compensation for the Architect’s additional services made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If
§ 2.4.1 If Contractor fails to complete the Work in accordance with time limit stipulated in the Certificate of Substantial Completion, then Owner may take over the completion of Work without advance notice to Contractor and without prejudice to any other remedy that Owner may have.

§ 2.4.2 In such cases as described in Sections 2.4.1 and 2.4.2, an appropriate modification will be issued deducting from the Contract Sum the reasonable cost of correcting such deficiencies or completing such Work, regardless of whether Owner actually undertakes correcting such Work, in which case the deduction shall be based on the Designer’s estimate in accordance with Section 7.3.6, including Owner’s expenses and compensation for the Designer’s additional services made necessary by such default, neglect, or failure. Such action by the Owner and amounts charged to Contractor are both subject to prior approval of the Designer. If the unpaid balance of the Contract Sum is not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

§ 2.4.3 In such cases as described in Sections 2.4.1 and 2.4.2, an appropriate modification will be issued deducting from the Contract Sum the reasonable cost of correcting such deficiencies or completing such Work, regardless of whether Owner actually undertakes correcting such Work, in which case the deduction shall be based on the Designer’s estimate in accordance with Section 7.3.6, including Owner’s expenses and compensation for the Designer’s additional services made necessary by such default, neglect, or failure. Such action by the Owner and amounts charged to Contractor are both subject to prior approval of the Designer. If the unpaid balance of the Contract Sum is not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

ARTICLE 3 CONTRACTOR

§ 3.1 GENERAL

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term “Contractor” means the Contractor or the Contractor’s term “Contractor” means the Contractor or the Contractor’s authorized representative. When the Agreement is a Construction Services Agreement between the Owner and a Construction Manager / General Contractor, the term “Contractor” means Construction Manager / General Contractor or its authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect-Designer in the Architect-Designer’s administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.1.4 At the time of bid and award, Contractor shall not be currently disqualified from participating in State construction projects under the supervision of the SBC. Such disqualification extends to succeeding or related corporations, partnerships, joint ventures, and other business organizations having substantial factual or legal connections, continuity, or identity with those that have been disqualified.

§ 3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.2.3, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor
shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor shall be promptly reported by the Contractor to the Designer as a request for information in such form as the Architect may require. It is recognized that the Contractor’s review is made in the Contractor’s capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents. Contractor shall not perform construction activity when Contractor knows, or should know in exercise of reasonable diligence, that the activity involves error, inconsistency, or omission in Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor shall be promptly reported by the Contractor to the Designer as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor’s notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall make Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3 with reasonable diligence, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations with reasonable diligence. If the Contractor performs those obligations with reasonable diligence, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor’s best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice and a proposal of corrective changes to the Owner and Architect and shall not proceed with that portion of the Work without further written instructions from the Architect. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Owner shall be solely responsible for any loss or damage arising solely from those Owner required means, methods, techniques, sequences or procedures. Designer that are accepted by the Contractor.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor’s employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 LABOR AND MATERIALS

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work. Contractor shall receive neither material, equipment, labor, nor services from one who submitted a competing general bid for the same Contract and subsequently withdrew, reneged, or otherwise failed to enter into the contract.

§ 3.4.2 Except in the case of minor changes in the Work authorized by the Architect in accordance with Sections 3.12.8 or 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive. Specified
materials, equipment, and systems are essential elements of the Contract. If Contractor desires to use another material, equipment, or system in lieu thereof, Contractor shall request approval in writing and shall submit samples and data, including an estimate of difference in cost, as required for Designer’s consideration. Designer and Owner will be final judge of acceptability of substitution. No substitution shall be made without authority in writing from Designer. Not later that 21 days after award of contract, Contractor shall provide a list showing names of manufacturers proposed for each specified product, and applicable name of installer, whether Contractor or subcontractor. Designer will within 14 days reply in writing to Contractor stating whether Owner or Designer, after due investigation, has reasonable objection to any such manufacturer or installer. If adequate data on proposed manufacturer or installer is not available, Designer may state that action will be deferred until Contractor provides further data. Contractor shall not make use of a manufacturer, or installer to which Owner or Designer has reasonably objected. Contractor shall receive appropriate adjustment in Contract Sum, Contract Time, or both for making such change unless objection was based on failure of manufacturer or installer to meet requirements of Contract Documents, in which case neither Contract Sum nor Contract Time shall be adjusted. Failure to object to a manufacturer shall not constitute waiver of requirements of Contract Documents. Products furnished by listed Contractor’s manufacturers must conform to requirement of Contract Documents.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor’s employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.4.4 Contractor shall disclose existence and extent of financial interests, whether direct or indirect, which Contractor has in proposed subcontractors and material suppliers.

§ 3.4.5 PROHIBITION OF ILLEGAL IMMIGRANTS
§ 3.4.5.1 The requirements of Public Acts of 2006, Chapter Number 878, of the State of Tennessee, addressing the use of illegal immigrants in the performance of any contract to supply goods or services to the State of Tennessee, shall be material provision of this Contract, a breach of which shall be grounds for monetary and other penalties, including termination of this Contract.

§ 3.4.5.2 The Contractor by entering into this contract attests, certifies, warrants, and assures that the Contractor shall not knowingly utilize the services of an illegal immigrant in the performance of this Contract and shall not knowingly utilize the services of any subcontractor or consultant who will utilize the services of any illegal immigrant in the performance of this Contract.

§ 3.4.5.3 The Contractor understands and agrees that failure to comply with this section will be subject to the sanctions of Public Chapter 878 of 2006 for acts or omissions occurring after its effective date. This law provides for the prohibition of a Contractor from contracting with, or submitting an offer, proposal, or bid to contract with the State of Tennessee to supply goods or services for a period of one year after a Contractor is discovered to have knowingly used the services of illegal immigrants during the performance of this Contract.

§ 3.4.5.4 For purposes of this Contract, "illegal immigrant" shall be defined as any person who is not either a United States citizen, a lawful permanent resident, or a person whose physical presence in the United States is authorized or allowed by the Department of Homeland Security and who, under Federal immigration laws and/or regulations, is authorized to be employed in the U.S. or is otherwise authorized to provide services under the Contract.

§ 3.4.6 NON-DISCRIMINATION IN EMPLOYMENT
§ 3.4.6.1 Contractor shall not discriminate against any employee nor applicant for employment because of race, creed, color, religion, sex, age, or national origin as defined in Tennessee Code Annotated (TCA) § 4-21-401, et seq, nor because of handicap, in accordance with TCA § 8-50-103.

§ 3.4.6.2 Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to handicap, race, creed, color, religion, sex, age, or national origin, including but not limited to practices in recruitment, recruitment advertising, employment, selection for training or apprenticeship, rates of pay or other forms of compensation, upgrading, demotion, transfer, layoff, or termination.

§ 3.4.6.3 Contractor shall post in conspicuous places, available to employees and applicants for employment, notices setting forth these policies of non-discrimination.
§ 3.4.6.4 Solicitations or advertisements for employees placed by or in behalf of Contractor shall state that qualified applicants shall receive consideration for employment without regard to handicap, race, creed, color, religion, sex, age, or national origin.

§ 3.4.7 PREVAILING WAGE SCALE
§ 3.4.7.1 Contractor is required to comply with policies, conditions and rules of the Tennessee Department of Labor and Workforce Development pursuant to TCA § 12-4-401, et seq, which include that if the Contract Sum exceeds $50,000, Contractor is required to pay Prevailing Wage Scale current in the area of the Project to laborers and mechanics employed on the Work, as set forth in said rules, policies, and statute, and to furnish weekly payrolls with the decision number noted on each to the Tennessee Department of Labor and Workforce Development.

§ 3.4.7.2 When a Federal Wage Scale will apply to the Project, it will be included in Contract Documents, and Contractor shall pay not less than rates set forth. If both federal and State wage rates apply to project, Contractor shall pay the higher of the two wage scales for each craft or trade.

§ 3.4.7.3 Current Prevailing Wage Scale Determination(s) for this project will be included in Contract Documents as part of the Conditions of the Contract, if Owner’s estimate of the value of Work indicates that it is required. Failure of Owner or Designer to provide current wage scale decision prior to bidding does not relieve Contractor of obligations set forth above.

§ 3.4.7.4 If Prevailing Wage Rates applicable to the Project change during the course of the Contract, or differ from those provided in Contract Documents, equitable adjustment in Contract Sum shall be made.

§ 3.4.8 REPORTING OF SUBCONTRACTORS
If the total Contract Sum equals or exceeds $100,000 (whether under the terms of the initial contract or by Modification), and the time of performance is more than six (6) months, Contractor shall fully comply with its obligations under TCA § 50-7-404(g) including but not limited to the subcontractor reporting requirements of subsection (g)(1).

§ 3.5 WARRANTY
The Contractor warrants to the Owner and Architect/Designer that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor’s warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect/Designer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.6 TAXES
The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.6.1 The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.6.2 If the State of Tennessee enacts, after bids are received or negotiations concluded, a change in a sales, consumer, use, or similar state tax for the Work or a portion thereof provided by the Contractor, the Contract Sum shall be accordingly adjusted by appropriate modification or the Owner may make other lawful provision to mitigate the change.

§ 3.6.3 Neither Contract Sum nor Contract Time shall be adjusted for impacts resulting from a change in a tax by a governmental body other than the State of Tennessee, regardless of when the tax is enacted or goes into effect.
§ 3.7 PERMITS, FEES, NOTICES, AND COMPLIANCE WITH LAWS
§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor, except as provided in Section 3.7.3, shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor, except as provided in this section performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions. If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents, excavations and other subsurface construction activity shall be considered unclassified down to design depth, regardless of substrate and abandoned or inactive infrastructure or (2) unknown physical conditions of an unusual nature, that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and the Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 ALLOWANCES
§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

.1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

.2 Contractor’s costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
.3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order Modification. The amount of the Change Order Modification shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor’s costs under Section 3.8; and

.4 Contractor shall monitor the costs included in allowances, and shall not incur excess costs without first obtaining a Modification adjusting the allowance sufficient for the excess.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 SUPERINTENDENT

§ 3.9.1 The Contractor shall employ and designate a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work through final inspection. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The superintendent, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the name and qualifications of a proposed superintendent. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to the proposed superintendent or (2) that the Architect requires additional time to review. Failure of the Architect to reply within the 14 day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect-Designer has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner’s consent, which shall not unreasonably be withheld or delayed.

§ 3.10 CONTRACTOR’S CONSTRUCTION SCHEDULES

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner’s and Architect-Designer’s information a Contractor’s construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

§ 3.10.2 The Contractor shall prepare a submittal schedule, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect-Designer’s approval. The Architect-Designer’s approval shall not unreasonably be delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor’s construction schedule, and (2) allow the Architect-Designer reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect-Designer.

§ 3.10.4 SCHEDULING ASSISTANCE

Owner may provide the Scheduling Assistance. If provided, such services will be set forth in the specification of Progress Schedules. If provided, the purpose of such services is to assist in producing a progress schedule for the Work; however, no express or implied guarantee or warrantee is provided by the Owner regarding the suitability of the derived schedules, and the Contractor retains full responsibility for the suitability of the schedules and for conforming to them. Contractor shall fully cooperate in developing a schedule, and shall require the necessary forces assisting the Contractor to likewise cooperate fully.

§ 3.10.5 COMMISSIONING CONSULTANT

Owner may provide the services of a Commissioning Consultant, either as a consultant engaged by the Owner, or as Subcontractor under a specified allowance and selected by the Owner. If provided, such services will be set forth in the Specifications. The Contractor retains full responsibility for compliance with the Contract Documents. Contractor shall fully cooperate in commissioning, and shall require the necessary forces assisting the Contractor to
likewise cooperate fully. If commissioning activities are included in the Work, they shall not be a cause for delay or cost claims.

§ 3.11 DOCUMENTS AND SAMPLES AT THE SITE
The Contractor shall maintain at the site for the Owner one copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect-Designer and shall be delivered to the Architect-Designer for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES
§ 3.12.1 Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. Their purpose is to demonstrate the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect-Designer is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect-Designer is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect-Designer without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve and submit to the Architect-Designer Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents in accordance with the submittal schedule approved by the Architect-Designer or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents to the Owner and Architect-Designer that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so prior to providing that which is the subject of the submittal, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents. If a portion of Work demonstrated by a submittal deviates from the requirements of the Contract Documents, the Contractor shall specifically identify the deviation and its difference in cost as a part of the submittal.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect-Designer.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect-Designer’s approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect-Designer in writing of such deviation and its difference in cost at the time of submittal and (1) the Architect-Designer has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect-Designer’s approval thereof.
§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect. The Architect’s approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor’s responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Designer will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed-design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional’s written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

§ 3.13 USE OF SITE
The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 CUTTING AND PATCHING
§ 3.14.1 The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting and patching shall be restored to the condition existing prior to the cutting, fitting and patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor’s consent to cutting or otherwise altering the Work.

§ 3.15 CLEANING UP
§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor’s tools, construction equipment, machinery and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 ACCESS TO WORK
The Contractor shall provide the Owner and the Architect access to the Work in preparation and progress wherever located.
§ 3.17 ROYALTIES, PATENTS AND COPYRIGHTS
The Contractor shall pay all royalties and license fees. The Contractor shall, subject to approval by the Attorney General of the State of Tennessee with respect to suits or claims against Owner, defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner or Architect. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.

§ 3.18 INDEMNIFICATION
§ 3.18.1 To the fullest extent permitted by law the Contractor shall indemnify and hold harmless the Owner, Architect, Architect’s consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys’ fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property, including loss of use resulting therefrom (other than the Work itself), but only to the extent caused by the willful or negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Section 3.18. Contractor agrees to indemnify the Owner and Owner’s consultants based on design mistakes and errors or omissions.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers’ compensation acts, disability benefit acts or other employee benefit acts.

§ 3.19 RELATIONS WITH OWNER’S REPRESENTATIVES
§ 3.19.1 Contractor, subcontractors, material suppliers, and sub-subcontractors shall neither offer nor give a product, service, payment, negotiable instrument, gift, gratuity, or other compensation in connection with this project to a representative or employee of the State of Tennessee, the Owner, the Designer, or the Designer’s consultants without Owner’s consent. Evidence of a violation of this requirement may be cause for termination of this Contract.

§ 3.20 PARTICIPATION OF MINORITY-OWNED BUSINESSES:
§ 3.20.1 To the extent that the Contractor or a subcontractor is a Minority-owned Business, the Contractor shall report to the State its own status in this regard and the names and amounts of contracts entered into with Minority-owned Businesses on State projects in order for the State to collect data on such participation.

§ 3.20.2 "Minority-owned Business" means a business which is solely owned, or at least 51 percent of the assets of outstanding stock of which is owned, by an individual who personally manages and controls the daily operations of such business, and who is impeded from normal entry into the economic mainstream because of past practices of discrimination based on race, religion, ethnic background, sex, or disability.

§ 3.20.3 To be a "Minority-owned Business" for the purposes of this contract, a business must be certified as a "Minority-owned Business" by an agency of the federal government or the government of the State of Tennessee which is normally engaged in the practice of providing such certification.

ARTICLE 4 DESIGNER
ARTICLE 4 ARCHITECT
§ 4.1 GENERAL
§ 4.1.1 The Owner shall retain an architect lawfully licensed to practice architecture or an entity lawfully practicing architecture in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the
§ 4.1.2 Duties, responsibilities and limitations of authority of the Architect-Designer as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner, Contractor and Architect-Designer. Consent shall not be unreasonably withheld.

§ 4.1.3 If the employment of the Architect-Designer is terminated, the Owner shall employ a successor architect as to whom the Contractor has no reasonable objection and the Designer whose status under the Contract Documents shall be that of the Architect-Designer.

§ 4.2 ADMINISTRATION OF THE CONTRACT

§ 4.2.1 The Architect-Designer will provide administration of the Contract as described in the Contract Documents and will be an Owner’s representative during construction until the date the Architect issues the final Certificate For Payment. The Architect (1) during construction, (2) until final payment is due and (3) at the Owner’s request during the one-year period for correction of Work described in Section 12.2. The Designer will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect-Designer will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, (1) to become generally familiar with the progress and quality of the portion of the Work completed, (2) endeavor to guard the Owner against defects and deficiencies in the Work, and (3) to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect-Designer will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect-Designer will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor’s rights and responsibilities under the Contract Documents, except as provided in Section 3.3.1.

§ 4.2.3 On the basis of the site visits, the Architect-Designer will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work. The Architect-Designer will not be responsible for the Contractor’s failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect-Designer will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION

Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect-Designer, about matters arising out of or relating to the Contract. Communications by and with the Architect’s Designers shall be through the Architect-Designer. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner, Owner, or the Owner’s Designer.

§ 4.2.5 Based on the Architect’s Designer’s evaluations of the Contractor’s Applications for Payment, the Architect-Designer will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect-Designer has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect-Designer considers it necessary or advisable, the Architect-Designer will have authority to require inspection or testing of the Work in accordance with Sections 13.5.2 and 13.5.3, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect-Designer nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect-Designer to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.
§ 4.2.7 The Architect-Designer will review and approve, or take other appropriate action upon, the Contractor’s submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect’s checking for compliance with the requirements and conformance with the intent of the Contract Documents. The Designer’s action will be taken in accordance with the submittal schedule approved by the Architect-Designer or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect’s professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect-Designer’s review of the Contractor’s submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5 and 3.12. The Architect-Designer’s review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect-Designer, of any construction means, methods, techniques, sequences or procedures. The Architect-Designer’s approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare or assist the Owner in preparing Change Orders and Construction Change Directives, and may authorize minor changes in the Work as provided in Section 7.4. The Architect-Designer will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect-Designer will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner’s review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect-Designer agree, the Architect-Designer will provide one or more project representatives to assist in carrying out the Architect-Designer’s responsibilities at the site. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents if requested by the Contractor.

§ 4.2.11 The Architect-Designer will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect-Designer’s response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect-Designer will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect-Designer will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will not be liable for results of interpretations or decisions rendered in good faith, according to a reasonable and professional standard of care.

§ 4.2.13 The Architect-Designer’s decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect-Designer will review and respond to requests for information about the Contract Documents. The Architect-Designer’s response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness, within 15 days. If appropriate, the Architect-Designer will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 DEFINITIONS

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a separate contractor or subcontractors of a separate contractor.
§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

§ 5.2.1 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable within 21 days after award of the Contract, shall furnish in writing to the Owner through the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has reasonable objection to any such proposed person or entity or (2) that the Architect requires additional time for review. Failure of the Owner or Architect to reply within the 14 day period shall constitute notice of no reasonable objection. No construction activity shall be commenced by a person or entity in question until all objections have been resolved. If required, Contractor shall furnish evidence satisfactory to Owner, showing each proposed Subcontractor is competent to execute work covered by the subcontract. Subcontractors identified as a part of Contractor’s bid for this project shall be used in the capacity listed, unless otherwise approved by the Owner in accordance with State Building Commission policy.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was able to meet requirements of Contract Documents and reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor’s Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsibly in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person or entity previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.2.5 Contractor shall not award subcontract to one who submitted a competing general bid for the same Contract and subsequently withdrew, reneged, or otherwise failed to enter into contract.

§ 5.2.6 Contractor shall not allow work under the Contract to be performed contrary to the requirements of Section 3.4.5 nor by a Contractor or Subcontractor that has been disqualified from participating in State construction projects under the supervision of the State Building Commission. Such disqualification extends to succeeding or related corporations, partnerships, joint ventures, and other business organizations having substantial factual or legal connections, continuity, or identity with those that have been disqualified. If such a participant is discovered, Contractor shall immediately discontinue the participation and provide a suitable substitute at no additional cost to the Owner, and provide documentation to the Owner of the action taken to comply with this requirement.

§ 5.3 SUBCONTRACTUAL RELATIONS

By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor’s Work, which the Contractor, by these Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor, so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents.
Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 CONTINGENT ASSIGNMENT OF SUBCONTRACTS

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor in writing; and

.1 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

Assignment is at the option of Owner, and creates no duty or obligation upon Owner to exercise this option, nor is any right created for any subcontractor to expect or rely upon such assignment. When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor’s rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor’s compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon such assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor’s obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 OWNER’S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

§ 6.1.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner’s own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Article 15—.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term “Contractor” in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner’s own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to the construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner’s own forces, the Owner shall be deemed to be subject to the same obligations and to have the same rights that apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6 and Articles 10, 11 and 12.

§ 6.2 MUTUAL RESPONSIBILITY

§ 6.2.1 The Contractor shall afford the Owner and separate contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor’s construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor’s Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect apparent discrepancies or defects in such other construction that would render it...
unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the Owner’s or separate contractor’s completed or partially completed construction is fit and proper to receive the Contractor’s Work, except as to defects not then reasonably discoverable.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a separate contractor because of the Contractor’s delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a separate contractor’s delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or separate contractors as provided in Section 10.2.5.

§ 6.2.5 The Owner and each separate contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 OWNER’S RIGHT TO CLEAN UP
If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect or Designer will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK
§ 7.1 GENERAL
§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor and Architect or Designer; a Construction Change Directive requires agreement by the Owner and Architect or Designer and may or may not be agreed to by the Contractor; an order for a minor change in the Work may be issued by the Architect or Designer alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or order for a minor change in the Work.

§ 7.2 CHANGE ORDERS
§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor and Architect or Designer stating their agreement upon all of the following:

.1 The change in the Work;
.2 The amount of the adjustment, if any, in the Contract Sum; and that the price includes all eligible overhead and profit, and represents all direct and indirect costs associated with the change; and
.3 The extent of the adjustment, if any, in the Contract Time.

§ 7.2.2 Unless otherwise agreed in writing by Owner and Contractor, the method of determining adjustments in Contract Sum shall be by one or more of the methods set forth in Section 7.3.3, and shall be based on reasonable expenditures and savings as set forth in Section 7.3.7.

§ 7.3 CONSTRUCTION CHANGE DIRECTIVES
§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect or Designer, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.
**§ 7.3.3** If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

1. Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
2. Unit prices stated in the Contract Documents or subsequently agreed upon;
3. Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
4. As provided in Section 7.3.7.

**§ 7.3.4** If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed in a proposed Change Order or Construction Change Directive so that application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted subject to limitation and requirements contained in the Contract Documents.

**§ 7.3.5** Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect-Designer of the Contractor’s agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

**§ 7.3.6** A Construction Change Directive signed by the Contractor indicates the Contractor’s agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

**§ 7.3.7** If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect-Designer shall determine the method and the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount, in accordance with Section 7.3.11. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect-Designer may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.7 shall be limited to the following:

**§ 7.3.7.1** Costs for the purpose of this Section 7.3.7 shall be limited to the following:

1. Costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers’ compensation insurance; Payroll Expense of labor;
2. Costs of materials, supplies and equipment, including cost of transportation, thereof, whether incorporated or consumed;
3. Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others, equipment rented from others, and not more than 80 percent of the Associated Equipment Distributors Nationally Averaged Rental Rates for Construction Equipment for machinery and equipment belonging to the Contractor;
4. Costs of premiums for all bonds and insurance, bonds and insurance to the extent required by Contract Documents, permit fees, and sales, use or other similar taxes related to the Work; and
5. Additional costs of supervision and field office personnel directly attributable to the change; Direct Payroll Expense of superintendent directly attributable to authorized overtime; and, reasonable Direct Payroll Expense of project manager and clerical work directly attributable to estimating and coordinating the change.
6. The following items are “Class 1 Time-Related Expenses”, and shall be considered as costs when Contract Time is extended due to additional work or a Class 1 cause defined in Section 8.3, and solely to the extent directly attributable to extension of time: field offices, sheds, phones, sanitary facilities, on-site utilities, drinking fountains, cleaning, safety programs, and other construction facilities and temporary controls not specifically required for additional work; costs of superintendent; superintendent’s vehicle; and other general use vehicles, being those requiring a class D, H, or M license, and excluding those requiring a class A, B, or C license, as set forth in the Tennessee Driver Handbook or comparable current successor publication of the Tennessee Department of Safety;
§ 7.3.7.2 DIRECT PERSONNEL EXPENSE (DPE)
§ 7.3.7.2.1 Direct payroll expense (DPE) costs delineated in Sections 7.3.7.1.1, 7.3.7.1.5, 7.3.7.1.6, and 7.3.7.1.7 shall be limited to base salary or hourly wage plus a maximum of 39 percent of base salary or hourly wage, and further limited to a maximum of $155 per hour, including all labor burden.

§ 7.3.7.2.2 If the Contract Sum is a Guaranteed Maximum Price between the Owner and a Construction Manager / General Contractor, and the proposal on which the CM/GC Master Contract is based identified a Labor Burden multiplier as a cost consideration, then the 39 percent maximum in Section 7.3.7.2.1 shall not apply, and the Labor Burden multiplier provided in the Proposal shall be used.

§ 7.3.7.3 Specifically excluded from costs and included in overhead or general requirements are: corporate, home office, and branch office overhead, rent, mortgage, off-site utilities, project management, and personnel not otherwise-mentioned; capital expenses and interest on capital; hand tools; and the items listed in Section 7.3.7.1.7 when Contract Time is not extended due to additional work or a Class 1 clause.

§ 7.3.7.4 To facilitate checking for increases or decreases in the Contract Sum, proposals shall be accompanied by Contractor’s complete itemization of costs of work including labor, materials and equipment, plus an amount for overhead and profit.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net-decrease in the Contract Sum shall be actual net cost as confirmed by the Architect-Designer. When both additions and credits covering related Work or substitutions are involved in a change, the allowance amount for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect’s professional judgment, to be reasonably justified. The Architect’s interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect-Designer concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a shall be recorded by preparation and execution of an appropriate Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.3.11 OVERHEAD AND PROFIT
§ 7.3.11.1 The amount for overhead and profit on costs as stipulated in Section 7.3.7 shall be: 10 percent overhead added to the itemized cost; plus 5 percent profit added to the itemized cost and overhead; plus 5 percent for the Contractor added to the itemized cost, overhead, and profit, when the itemized cost is for work performed by a subcontractor or sub-subcontractor.

§ 7.3.11.2 When the Contract Sum is a Guaranteed Maximum Price between the Owner and a Construction Manager / General Contractor, the extra 5 percent for the Contractor in Section 7.3.11.1 shall not apply. In such cases, the CM/GC Fee shall apply in accordance with the Master Contract provisions for Modifications and Change in GMP.
§ 7.4 MINOR CHANGES IN THE WORK

The Architect has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes will be effected by written order signed by the Architect and shall be binding on the Owner and Contractor.

ARTICLE 8 TIME

§ 8.1 DEFINITIONS

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 PROGRESS AND COMPLETION

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 to be furnished by the Contractor and Owner. The date of commencement of the Work shall not be changed by the effective date of such insurance.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time in accordance with the Agreement.

§ 8.3 DELAYS AND EXTENSIONS OF TIME AND FORCED ACCELERATION

§ 8.3.1.1 Class 1 causes: an act or failure to act that is contrary to the Contract Documents on the part of Owner or Architect or an employee of either, or of a separate Contractor employed by Owner, or an act or failure to act that is contrary to the Contract Documents on the part of Owner or Architect, or of an employee of either, or of a separate Contractor employed by Owner, or an injunction against Owner or Owner’s representatives.

§ 8.3.1.2 Class 2 causes: abnormal weather, acts of God, riots, civil commotion, acts of War, fire, unavoidable casualties, epidemics, quarantine restrictions, labor disputes, unusual delay in transportation, freight embargoes, or insolvency of subcontractors, sub-subcontractors, or suppliers.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15. If the basis exists for an extension of time under Section 8.3.1, Owner may either:
§ 8.3.2.1 in the case of additional work or a Class 1 cause, assign the Class 1 Time-Related Expenses, defined in Section 7.3.7.1.7, plus the overhead and profit allowed in Section 7.3.11, to a special allowance that can be earned based upon the extent of actual use of the related Time Extension in completion of the Work;

§ 8.3.2.2 accept the reasonable and appropriate time extension as determined by Designer to cover such delay, and in the case of a Class 2 cause, there will be no corresponding adjustment in Contract Sum, and the sole recourse of Contractor will be entitlement to time extension as provided by Designer regardless of actual source or cause of delay;

§ 8.3.2.3 order Contractor to accelerate construction activity by working overtime and by adding extra forces in order to overcome such delays, and adjusting the Contract Sum in accordance with Article 7 to compensate Contractor for such directed acceleration; however, direct costs used in determining such compensation shall be limited to properly substantiated and documented premium or overtime labor costs; or,

§ 8.3.2.4 employ a combination of the above remedies.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents. Neither Owner nor Designer will be obligated or liable to Contractor for, and Contractor hereby expressly waives claims against Owner and Designer on account of damages, costs, expenses, or related impacts which Contractor, subcontractors, sub-subcontractors, suppliers, or other persons may incur as a result of a Class 2 cause enumerated in Section 8.3.1. Contractor’s sole and exclusive remedy and full compensation in such event shall be extension of Contract Time in accordance with provisions of the Contract Documents. Contractor likewise waives claims of damages, costs, or expenses due to a delay resulting from a Class 1 cause except and solely to the extent of costs allowed under Section 7.3.7.

§ 8.3.4 Claims relating to time shall be made in accordance with applicable provisions of Article 15 or shall receive no consideration. If monthly Weather Delay Reports are required by the specifications, then claims for time extension based upon weather delays will be denied if a submitted report does not corroborate the Claim or if no report was submitted when it was required, and Contractor waives the right to such claims.

§ 8.3.5 Extensions of time shall be implemented in accordance with Article 7.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 CONTRACT SUM
The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents. The Contract Sum is not subject to change due to commodity, equipment, or labor cost fluctuations.

§ 9.2 SCHEDULE OF VALUES
Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit to the Architect-Designer, before the first Application for Payment, a schedule of values allocating the entire Contract Sum to the various portions of the Work and prepared in such form and supported by such data to substantiate its accuracy as the Architect-Designer may require. This schedule, unless objected to by the Architect-Designer, shall be used as a basis for reviewing the Contractor’s Applications for Payment. If during construction the Schedule of Values ceases to accurately represent the allocation of the Contract Sum, the Contractor shall submit a revised Schedule of Values.

§ 9.3 APPLICATIONS FOR PAYMENT
§ 9.3.1 At least ten days before Prior to the date established for each progress payment, the Contractor shall submit to the Architect-Designer an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2., for completed portions of the Work. Such application shall be notarized, if required. The total completed value in the continuation sheet of the application for payment cannot exceed the scheduled value. Such application shall be notarized, and supported by such data substantiating the Contractor’s right to payment as the Owner or Architect-Designer may require, such as copies of requisitions from Subcontractors and material suppliers, and shall reflect retainage if provided for in the Contract Documents.
§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or material supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner’s title to such materials and equipment or otherwise protect the Owner’s interest, and shall include the costs of applicable insurance, storage and transportation to the site for such materials and equipment stored off the site, extent those costs have been included in the Contract Sum and actually incurred. Additional costs, which may be attendant to the off-site storage, are the responsibility of the Contractor, and cannot be claimed by Contractor against Owner.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment, at the time payment is received by the Contractor. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor’s knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

§ 9.3.4 In Applications for Payment, the amount represented as total completed and stored to date shall reflect the portion of the Contract Sum properly allocable to labor, materials, and equipment incorporated in the Work and materials and equipment suitably stored in accordance with Section 9.3.2, and not exceed the Contract Sum less the value of incomplete Work and corrections required. This total completed and stored to date shall not be construed to define completion as determined by substantial completion or final completion of the Work according to Sections 9.8, 9.9, or 9.10.

§ 9.3.5 Applications for Payment shall indicate retainage withheld from the total completed and stored to date as follows: 5 percent until acceptance of a certificate of Substantial Completion; and, thereafter 2 percent until final payment. The resulting amount shall be indicated as the total earned less retainage. Applications that reduce retainage shall be accompanied by Consent or Surety, if a bond was required according to Section 11.4.

§ 9.3.6 Applications for Payment shall indicate the total earned less retainage, and the aggregate of previous payments made subtracted therefrom, and an amount requested.

§ 9.4 CERTIFICATES FOR PAYMENT

§ 9.4.1 The Architect-Designer will, within seven days after receipt of the Contractor’s Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect-Designer determines is properly due, or notify the Contractor and Owner in writing of the Contractor’s reasons for withholding certification in whole or in part as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect-Designer to the Owner, based on the Architect-Designer’s evaluation of the Work and the data comprising the Application for Payment, that, to the best of the Architect-Designer’s knowledge, information and belief, the Work has progressed to the point indicated and that the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Architect-Designer. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Architect-Designer has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the materials and equipment relating to the Work.
Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor’s right to payment, or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 DECISIONS TO WITHHOLD CERTIFICATION

§ 9.5.1 The Architect-Designer may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect-Designer’s opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect-Designer is unable to certify payment in the amount of the Application, the Architect-Designer will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect-Designer cannot agree on a revised amount, the Architect-Designer will promptly issue a Certificate for Payment for the amount for which the Architect-Designer is able to make such representations to the Owner. The Architect-Designer may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect-Designer’s opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

1. defective Work not remedied;
2. third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;
3. failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
4. reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
5. damage to the Owner or a separate contractor;
6. reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
7. repeated failure to carry out the Work in accordance with the Contract Documents; or
8. potential liquidated damages and other unsettled claims.

§ 9.5.2 When any of the above reasons for withholding certification are removed, certification will be made for respective amounts previously withheld.

§ 9.5.3 If the Architect-Designer withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or material or equipment suppliers to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect-Designer and the Architect-Designer will reflect such payment on the next Certificate for Payment.

§ 9.6 PROGRESS PAYMENTS

§ 9.6.1 After the Architect-Designer has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect-Designer in accordance with TCA § 12-4-701 et seq., as may from time to time be amended.

1. Payment is due not later than 45 days after an undisputed Certificate for Payment has been received by the Owner. Owner will endeavor to make payment within 21 days, but shall not be obligated to do so.
2. Based upon Certificates for Payment issued by the Designer, correcting the Application for Payment as appropriate, the Owner shall make progress payments to the Contractor as provided in the Contract Documents.

§ 9.6.2 The Contractor shall pay each Subcontractor no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of amounts applied for by the Contractor and action taken thereon by the Architect-Designer and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.3 The Architect-Designer and Owner will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect-Designer and Owner on account of portions of the Work done by such Subcontractor.
§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors to ascertain whether they have been properly paid. Neither the Owner nor the Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor, except as may otherwise be required by law.

§ 9.6.5 Contractor payments to material and equipment suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors and suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision. When Contract-Sum meets the statutory threshold, the Contractor shall comply with the procedures established by the Tennessee State Treasurer and Department of Finance and Administration for establishment of an interest-bearing retainage escrow account.

§ 9.7 FAILURE OF PAYMENT
If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor’s Application for Payment, or if the Owner does not pay the Contractor within seven days after the date payment is due as established in the Contract Documents the amount certified by the Architect or awarded by binding dispute resolution, currently due as of that date pursuant to the terms of the Contract Documents (including certification by the Designer), then the Contractor may, upon seven additional days’ written notice to the Owner and Architect, stop the Work until payment of the amount owing due has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor’s reasonable costs of shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 SUBSTANTIAL COMPLETION
§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use. In order to occupy or utilize the Work for its intended use, Owner must have received complete Product Data, Operating and Maintenance Data, orientation, and training, as may be required by specifications, and use and occupancy permits.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor’s list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect’s inspection discloses any item, whether or not included on the Contractor’s list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, correct or complete such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.
§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect Designer will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. The Certificate, subject to the provisions of Section 9.12.2. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 PARTIAL OCCUPANCY OR USE

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer as required under Section 11.3.1.5 and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect Designer as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect Designer.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor and Architect Designer shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 FINAL COMPLETION AND FINAL PAYMENT

§ 9.10.1 Upon receipt of the Contractor’s written notice that the Work is ready for final inspection and acceptance and the payment required by the Contract Documents to remain in force after final payment is not currently in effect, the Architect Designer will promptly make such inspection and, when the Architect Designer finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect Designer will promptly issue a final Certificate for Payment stating that the entire balance found to be due the Contractor is due and payable. The Architect Designer’s final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor’s being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect Designer (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner’s property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days’ prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of lien, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond shall furnish acknowledgement of the matter from the Surety satisfactory to the Owner to indemnify the Owner against such lien. If such lien such matter in lieu of such a release or waiver. If such matter
§ 9.10.4 The making of final payment shall not constitute a waiver of Claims by the Owner except those arising from the following:

.1 items, Claims, security interests or encumbrances arising out of the Contract and unsettled;
.2 failure of the Work to comply with the requirements of the Contract Documents; or
.3 terms of special warranties required by the Contract Documents.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

§ 9.10.6 Final payment constituting the entire unpaid balance of Contract Sum, shall be paid by Owner to Contractor when Work has been completed, the Contract fully performed, and a final Certificate for Payment issued by Designer.

§ 9.11 METHOD OF PAYMENT

§ 9.11.1 Payments to Contractor shall be made through Owner’s automated clearing house wire transfer system. Contractor shall have completed an Authorization Agreement for Automatic Deposits ACH Credits Form prior to commencing Work and prior to submitting a first application for payment.

§ 9.11.2 Debit entries to correct errors authorized by the Authorization Agreement for Automatic Deposits ACH Credits Form shall be limited to those errors detected prior to the effective date of the credit entry. The remittance advice shall note that a correcting entry was made. Corrections shall be made within two banking days of the effective date of the original transaction. Other errors detected at a later date shall take the form of a refund, or in some instances, a credit memo if additional payments are to be made.

§ 9.11.3 The Owner reserves the right to deduct from amounts which are or shall become due and payable to Contractor under this or any contract between the parties any amounts which are or shall become due and payable to the State by the Contractor.

§ 9.12 LIQUIDATED DAMAGES

§ 9.12.1 Time being of the essence, Contractor further agrees to accept conditions for liquidated damages in the amount set forth in Contract Documents for each calendar day in excess of allotted time for Substantial Completion, or approved extension thereof, parties agreeing that the amount of damages resulting from delay would be uncertain and difficult to prove, and further agreeing that such liquidated damages set forth in the Owner-Contractor Agreement are a reasonable estimate of those damages which could result from delay.

§ 9.12.2 If a portion of the Work is certified Substantially Complete, the amount of Liquidated Damages applicable to the remaining Work may be reduced by written mutual agreement.

§ 9.12.3 Secondary Liquidated Damages shall be 25 percent of that originally required by the Contract Documents, and shall accrue until such time that Work has been completed and the Contract fully performed if:

.1 the time for completion stipulated in the Certificate of Substantial Completion has passed; or, if no such time was stipulated, then 30 calendar days has passed following the certified date of Substantial Completion and:

remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien matter including all costs and reasonable attorneys’ fees.
ARTICLE 10  PROTECTION OF PERSONS AND PROPERTY

§ 10.1 SAFETY PRECAUTIONS AND PROGRAMS
The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 SAFETY OF PERSONS AND PROPERTY

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to:
1. employees on the Work and other persons who may be affected thereby;
2. the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor’s Subcontractors or Sub-subcontractors; and
3. other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss.

§ 10.2.3 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3, except damage or loss attributable to acts or omissions of the Owner or Architect Designer or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. Owner reserves the right to effect repairs to damaged property and deduct all costs from the Contract Sum. The foregoing obligations of the Contractor are in addition to the Contractor’s obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor’s organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor’s superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect Designer.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 INJURY OR DAMAGE TO PERSON OR PROPERTY
If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 HAZARDOUS MATERIALS

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to
§ 10.3.2 Upon receipt of the Contractor’s written notice, pursuant to circumstances described in Section 10.3.1, Owner will have the option to either terminate the contract as provided in Article 14, proceed with Contractor in a mutually agreed plan of action, or as follows: the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect-Designer the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material or substance or who are to perform the task of removal or safe containment of such material or substance. The Contractor and the Architect-Designer will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect-Designer has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect-Designer have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, Following claim and modification processes in accordance with Articles 15 and 7, the Contract Time shall be extended appropriately and the Contract Sum shall be increased in the amount of the Contractor’s reasonable additional costs of shut-down, delay and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect’s consultants and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys’ fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury or to destruction of tangible property (other than the Work itself), except to the extent that such damage, loss or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for materials or substances required by the Contract Documents, except to the extent of the Contractor’s fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall indemnify the Owner for the cost and expense the Owner incurs (1) for remediation of a material or substance the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner’s fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all cost and expense thereby incurred.

§ 10.4 EMERGENCIES
In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor’s discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11  INSURANCE AND BONDS
§ 11.1 CONTRACTOR’S LIABILITY INSURANCE
§ 11.1.1 The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurance required by the Contract Documents as will protect the Contractor and the Owner from claims set forth below which may arise out of or result from the Contractor’s operations and completed operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:
.1 Claims under workers’ compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed;

.2 Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor’s employees;

.3 Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor’s employees;

.4 Claims for damages insured by usual personal injury liability coverage;

.5 Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, property on or away from the site, including loss of use resulting therefrom;

.6 Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;

.7 Claims for bodily injury or property damage arising out of completed operations; and

.8 Claims involving contractual liability insurance applicable to the Contractor’s obligations under Section 3.18.

§ 11.1.2 The insurance required by Section 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence- or claims-made basis, shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor’s completed operations coverage, until the expiration of the period for correction of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents one year after final payment. Specific lines of coverage and limits of liability provided by the Contractor shall be written in a comprehensive form satisfactory to the Owner in the following minimum requirements:

.1 Comprehensive General Liability, with combined single limits for bodily injury and property damage of

   Each Occurrence..................$1,000,000
   Aggregate..........................$2,000,000

   and including:
   premises & operations;
   underground, explosion, & collapse;
   products & completed operations;
   contractual;
   independent contractors;
   Owner / Contractor protective;
   broad form property damage; and,
   personal injury (employment exclusion deleted).

.2 Asbestos abatement insurance:

   Non-friable asbestos: If removal or abatement of non-friable asbestos is included in the Work, and Contractor’s General Liability Insurance coverage excludes risks associated with asbestos, Contractor shall provide evidence of a Special Endorsement.

   Friable asbestos: If removal or abatement of friable asbestos is included in the Work, Contractor shall provide evidence of a special endorsement.

   Special Endorsement: Evidence of a Special Endorsement shall be in the form of a Certificate of Insurance certifying a special endorsement for asbestos abatement insurance with a minimum $500,000 limit of liability. If Contractor is performing no portion of the asbestos removal or abatement with its own forces, Contractor, in lieu of its own such endorsement, may substitute a Certificate showing such special endorsement covering the subcontractor or sub-subcontractor which is actually performing the asbestos removal or abatement.

.3 Comprehensive Automobile Liability, with combined single limits for bodily injury and property damage of

   Each Occurrence..................$500,000

   and including owned, hired, and non-owned vehicles; or, if there are no owned vehicles, Contractor may provide written certification of such and provide coverage limited to hired and non-owned vehicles.

.4 Workers Compensation and Employer’s Liability, (without restriction as to whether covered by Workmen’s Compensation law), with Workers Compensation according to statute, and Employer’s Liability:............ $100,000.

.5 If an exposure exists, Aircraft and Watercraft Liability (owned & non-owned), with limits approved by Owner shall be provided.
§ 11.1.3 Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least thirty (30) days' prior written notice has been given to the Owner. Certificate(s) of insurance provided to attest to coverage shall specifically cite each element of coverage and not less than limits set forth in Section 11.1.2, as confirmation of complete coverage, and shall identify Contractor, Producer, Insurance Carrier, Project, and certificate holder, and state Producer's notice requirements as set forth in Section 11.1.4. The term "Commercial General Liability" shall mean all of the coverage listed in Section 11.1.2.1.a unless specifically noted otherwise in the certificate. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.

§ 11.1.4 The Contractor shall cause the commercial liability coverage required by the Contract Documents to include:

(1) the Owner, the Architect-Designer and the Architect's-Designer's Consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations.

§ 11.1.5 Contractor shall notify Owner in writing of changes in coverage or carrier not later than ten days after notification of Contractor by Producer, or ten days before Contractor makes a change, whichever occurs first. Contractor shall require that if policies are cancelled or modified before expiration date thereof, Producer shall endeavor to mail ten days prior written notice to certificate holder named therein.

§ 11.2 OWNER'S LIABILITY INSURANCE

The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

§ 11.3 PROPERTY INSURANCE

§ 11.3.1 Unless otherwise provided, the Owner shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance written on a builder's risk "all-risk" or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract Modifications and cost of materials supplied or installed by others, comprising total value for the entire for the covered Project at the site on a replacement cost basis without optional deductibles basis. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.3 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project specify the Owner as named insured, and the Contractor, Subcontractors and Sub-subcontractors as additional insured under the policy.

§ 11.3.1.1 Property insurance shall be on an "all-risk" or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for Architect's-Designer's services and Contractor's services and expenses work required as a result of such insured loss. Such insurance carried by Owner will include a $10,000 deductible clause. The deductible is the responsibility of the Contractor.

§ 11.3.2 If the Owner does not intend to purchase such property insurance required by the Contract and with all of the coverages in the amount described above, the Owner shall so inform the Contractor in writing prior to commencement of the Work. The Contractor may then effect insurance that will protect the interests of the Owner as named insured, Contractor, Subcontractors and Sub-subcontractors in the Work, and by appropriate Change Order if not included in the Contract Sum the cost thereof shall be charged to the Owner. If the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain insurance as described above, without so notifying the Contractor in writing, then the Owner shall bear all reasonable costs properly attributable thereto.
§ 11.3.1.3 If the property insurance requires deductibles, the Owner shall pay costs not covered because of such deductibles.

§ 11.3.1.4 This The Owner’s property insurance shall cover exclude portions of the Work stored off the site, and also portions of the Work in transit or in transit; and, Contractor shall provide insurance upon such portions to protect the Owner’s Interest.

§ 11.3.5 Partial occupancy or use in accordance with Section 9.9 shall not commence until the insurance company or companies providing property insurance have consented to such partial occupancy or use by endorsement or otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

§ 11.3.2 BOILER AND MACHINERY INSURANCE
The Owner shall purchase and maintain boiler and machinery insurance required by the Contract Documents or by law, which shall specifically cover such insured objects during installation and until final acceptance by the Owner; this insurance shall include interests of the Owner, Contractor, Subcontractors and Sub-subcontractors in the Work, and the Owner and Contractor shall be named insureds.

§ 11.3.3 LOSS OF USE INSURANCE
The Owner, at the Owner’s option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner’s property due to fire or other hazards, however caused. The Owner waives all rights of action against the Contractor for loss of use of the Owner’s property, including consequential losses due to fire or other hazards however caused.

§ 11.3.4 If the Contractor requests in writing that insurance for risks other than those described herein or other special causes of loss be included in the property insurance policy, the Owner shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order.

§ 11.3.5 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, the Owner shall waive all rights in accordance with the terms of Section 11.3.7 for damages caused by fire or other causes of loss covered by this separate property insurance. All separate policies shall provide this waiver of subrogation by endorsement or otherwise.

§ 11.3.6 Before an exposure to loss may occur, the Owner shall file with the Contractor a copy of each policy that includes insurance coverages required by this Section 11.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. Each policy shall contain a provision that the policy will not be canceled or allowed to expire, and that its limits will not be reduced, until at least 30 days’ prior written notice has been given to the Contractor issuing company will endeavor to provide ten days written notice to the Owner to provide the Contractor should the policy be canceled prior to the expiration date. Failure to mail such notice shall impose no obligation or liability of any kind upon the Owner or issuing company.

§ 11.3.7 WAIVERS OF SUBROGATION
The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents and employees, each of the other, and (2) the Architect, Architect’s consultants, separate contractors described in Article 6, if any, and any of their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other causes of loss to the extent covered by property insurance obtained pursuant to this Section 11.3 or other property insurance applicable to the Work, except such rights as they have to proceed of such insurance held by the Owner as fiduciary. The Owner or Contractor, as appropriate, shall require of the Architect, Architect’s consultants, separate contractors described in Article 6, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance
§ 11.3.8 A loss insured under the Owner’s property insurance shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgage clause and of Section 11.3.10. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

§ 11.3.9 If required in writing by a party in interest, the Owner as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Owner’s duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Owner shall deposit in a separate account proceeds so received, which the Owner shall distribute in accordance with such agreement as the parties in interest may reach, or as determined in accordance with the method of binding dispute resolution selected in the Agreement between the Owner and Contractor. If after such an insured loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor after notification of a Change in the Work in accordance with Article 4-7; however, this shall not preclude Owner’s emergency repairs under Section 10.2.5.

§ 11.3.10 The Owner as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Owner’s exercise of this power; if such objection is made, the dispute shall be resolved in the manner selected by the Owner and Contractor as the method of binding dispute resolution in the Agreement. If the Owner and Contractor have selected arbitration as the method of binding dispute resolution, the Owner as fiduciary shall make settlement with insurers or, in the case of a dispute over distribution of insurance proceeds, in accordance with the directions of the arbitrators.

§ 11.4 PERFORMANCE BOND AND PAYMENT BOND

§ 11.4.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract. If the initial Contract Sum as awarded exceeds $100,000, Contractor shall provide Contract Bond, in the amount of 100 percent of Contract Sum covering faithful performance of contract and payment of obligations arising thereunder. If a Contract Bond is required, and a Three Year Roof Bond is also stipulated in the Bidding Documents, then the Three Year Roof Bond shall be provided as stipulated. Bond(s) shall be executed on Tennessee State Building Commission Standard Form(s) exhibited in Bidding Documents for project, and subject to provisions of Section 11.4.3.

§ 11.4.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor and Owner shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.4.3 Surety is the person or entity identified as such in a bond and is referred to throughout the Contract Documents as if singular in number. The term “Surety” means the Surety or the Surety’s authorized representative. Surety Company issuing bond shall be licensed to transact business in Tennessee by the Department of Commerce and Insurance. Bonds shall have certified and current Power-of-Attorney for the Surety’s Attorney-in-Fact attached. Attorney-in-Fact who executes bond on behalf of Surety shall be one who is licensed by Tennessee as a resident agent, and shall affix license number to bond; or, countersignature by and license number of a licensed resident agent shall be affixed to the bond in addition to the signature of the Attorney-in-Fact.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 UNCOVERING OF WORK

§ 12.1.1 If a portion of the Work is covered contrary to the Architect’s Designer’s written request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, Designer, be uncovered for the Architect’s Designer’s examination and be replaced at the Contractor’s expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect Designer has not specifically requested in writing to examine prior to its being covered, the Architect-Designer may request in writing to see such Work and it
shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner’s expense. If such Work is not in accordance with the Contract Documents, such costs and the cost of uncovering, correction and recovering shall be at the Contractor’s expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

§ 12.2 CORRECTION OF WORK

§ 12.2.1 BEFORE OR AFTER SUBSTANTIAL COMPLETION

The Contractor shall promptly correct Work rejected by the Architect/Designer or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect/Designer’s services and expenses made necessary thereby, shall be at the Contractor’s expense.

§ 12.2.2 AFTER SUBSTANTIAL COMPLETION

§ 12.2.2.1 In addition to the Contractor’s obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor of known noncomplying Work and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming noncomplying Work within a reasonable time during that period after receipt of notice from the Owner or Architect/Designer, the Owner may correct it in accordance with Section 2.4. If Three Year Roof Bond has been provided, then with regard to the total roofing system, its installation, and materials, the one year time period hereunder is extended for two additional years for a total period of three years. Until such time as the three years hereunder have expired, Contractor’s obligations hereunder shall be joint and several with Company as defined and set forth in the Roofing System Warranty. For the purpose of Section 12.2.2, all of Company’s actions, whether of omission or commission, pursuant to the Roofing System Warranty are likewise actions of Contractor hereunder and shall in no way negate or reduce the responsibilities of Contractor hereunder.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor’s correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 and time period of applicable special warranties relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor’s liability with respect to the Contractor’s obligations other than specifically to correct the Work.
§ 12.3 ACCEPTANCE OF NONCONFORMING WORK

ACCEPTANCE OF INCOMPLETE OR NONCONFORMING WORK

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its completion or removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13  MISCELLANEOUS PROVISIONS

§ 13.1 GOVERNING LAW

The Contract shall be governed by the law of the place where the Project is located except that, if the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4, located.

§ 13.2 SUCCESSORS AND ASSIGNS

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to covenants, agreements and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner’s rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate such assignment.

§ 13.3 WRITTEN NOTICE

Written notice shall be deemed to have been duly served if delivered in person to the individual, to a member of the firm or entity, or to an officer of the corporation for which it was intended; or if delivered at, or sent by registered or certified mail or by courier service providing proof of delivery to, the last business address known to the party giving notice.

§ 13.4 RIGHTS AND REMEDIES

§ 13.4.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

§ 13.4.2 No action or failure to act by the Owner, Architect-Designer or Contractor shall constitute a waiver of a right-or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence-in a breach there under, except as may be specifically agreed in writing.

§ 13.4.3 If normal procedures within the Contract fail to satisfy a Claim against the Owner, further action is to be taken up with the Tennessee Claims Commission, pursuant to TCA § 9-8-101, et seq. Damages recoverable against the State shall be limited expressly to claims awarded by the Commission.

§ 13.5 TESTS AND INSPECTIONS

§ 13.5.1 Tests, inspections and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Architect-Designer timely notice of when and where tests and inspections are to be made so that the Architect-Designer may be present for such procedures. The Owner shall bear costs of (1) tests, inspections or approvals that do not become required until after bids are received or negotiations concluded, and (2) tests, inspections or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.

§ 13.5.2 If the Architect-Designer, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Section 13.5.1, the Architect-Designer will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the
§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure including those of repeated procedures and compensation for the Architect-Designer’s services and expenses shall be at the Contractor’s expense.

§ 13.5.4 Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect-Designer.

§ 13.5.5 If the Architect-Designer is to observe tests, inspections or approvals required by the Contract Documents, the Architect-Designer will do so promptly and, where practicable, at the normal place of testing.

§ 13.5.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.6 INTEREST
Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located past due as stated in Section 9.6.1 in accordance with TCA § 12-4-704 as may from time to time be amended.

§ 13.7 TIME LIMITS ON CLAIMS
The Owner and Contractor shall commence all claims and causes of action, whether in contract, tort, breach of warranty or otherwise, against the other Owner arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in the Agreement and Contract Documents and Section 13.4.3 within the time period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all claims and causes of action not commenced in accordance with this Section 13.7.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT
§ 14.1 TERMINATION BY THE CONTRACTOR
§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

.1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;

.2 An act of government, such as a declaration of national emergency that requires all Work to be stopped; or

.3 Because the Architect-Designer has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or

.4 The Owner has failed to furnish to the Contractor promptly, upon the Contractor’s request, reasonable evidence as required by Section 2.2.1. Documents.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, repeated suspensions, delays or interruptions of the entire Work by the Owner as described in Section 14.3 constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days’ written notice to the Owner and Architect-Designer, terminate the Contract and recover from the Owner payment for-
Work executed, including reasonable overhead and profit, costs incurred by reason of such termination, and damages—eligible overhead, profit, and costs as defined in Section 7.3.7 incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has repeatedly failed to fulfill the Owner’s obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days’ written notice to the Owner and the Architect,Designer, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 TERMINATION BY THE OWNER FOR CAUSE
§ 14.2.1 The Owner may terminate the Contract if the Contractor
.1 repeatedly refuses or repeatedly fails to supply enough properly skilled workers or proper materials;
.2 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
.3 repeatedly disregards or repeatedly fails to comply with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
.4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the above reasons exist, the Owner, upon certification by the Initial Decision Maker,Designer, that sufficient cause exists to justify such action, may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor’s surety, if any, seven days’ written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:
.1 Exclude the Contractor from the site and take possession of all Work, the site, and all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
.2 Accept assignment of subcontracts pursuant to Section 5.4; and
.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect’s-Designer’s services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker,Designer, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 SUSPENSION BY THE OWNER FOR CONVENIENCE
§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent
.1 that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or
.2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 TERMINATION BY THE OWNER FOR CONVENIENCE
§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner’s convenience and without cause.

§ 14.4.2 Upon receipt of written notice from the Owner of such termination for the Owner’s convenience, the Contractor shall
.1 cease operations as directed by the Owner in the notice;
.2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; including materials for which Owner has paid and which are stored off-site, and

.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner’s convenience, the Contractor shall be entitled to receive payment for Work executed, and costs of the completed portion of the Work, eligible costs as defined in Section 7.3.7 incurred by reason of such termination, along with reasonable overhead and profit on the Work not executed plus a fraction of 5 percent of the remaining balance of the Contract Sum, which fraction shall be equal to the value of Work completed divided by the Contract Sum.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 CLAIMS

§ 15.1.1 DEFINITION

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim.

§ 15.1.2 NOTICE OF CLAIMS

Claims by either the Owner or Contractor except claims of liquidated damages, must be initiated by written notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Designer. Claims by either party must be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later. If the effect of the condition giving rise to the Claim cannot be fully evaluated, a preliminary notice of pending claim shall be made within the stated time limit subject to further action in a timely manner.

§ 15.1.3 CONTINUING CONTRACT PERFORMANCE

Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents. The Architect will prepare Change Orders and issue Certificates for Payment in accordance with the decisions of the Initial Decision Maker. Designer will issue recommendations for change orders and certificates for payment in accordance with its decisions issued pursuant to Section 15.2.5.

§ 15.1.4 CLAIMS FOR ADDITIONAL COST

If the Contractor wishes to make a Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work, required by the Contract Documents shall be given to the Owner by the Contractor, and written notice received by the Contractor from Owner acknowledging the claim and authorizing construction activity to proceed, before the Contractor shall proceed to execute the construction activity giving rise to the claim; thence, the claim shall be addressed under provisions of Section 15.2. Documentation of claims shall conform to the requirements of Article 7. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.5 CLAIMS FOR ADDITIONAL TIME

§ 15.1.5.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, written notice as provided herein shall be given. The Contractor’s Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. To make Claim for an increase in Contract Time, Contractor shall give written notice as provided herein, and include an estimate of cost, which shall be limited to that allowed by Section 8.3.3, and an explanation of the cause and probable effect on progress of Work. In the case of a continuing delay, only one Claim is necessary, and the Contractor shall subsequently detail the full scope of the delay.

§ 15.1.5.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated and had an adverse effect on the scheduled construction.
.§ 15.1.6 CLAIMS FOR CONSEQUENTIAL DAMAGES

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

1. damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

2. damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work. The Contractor waives Claims against the Owner for consequential damages arising out of or relating to this Contract including but not limited to either party’s termination in accordance with Article 14, principal office expenses, including the compensation of personnel stationed at the principal office, and any damages for losses of financing, business, and reputation, and for loss of profit.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party’s termination in accordance with Article 14. Nothing contained in this Section 15.1.6 shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

.§ 15.2 INITIAL DECISION

.§ 15.2.1 Claims, excluding those arising under Sections 10.3, 10.4, 11.3.9, and 11.3.10, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be referred to the Initial Decision Maker for initial decision. An initial decision or other action by the Designer in accordance with Section 15.2.2 shall be required as a condition precedent to mediation of any Claim arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Initial Decision Maker with no decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner—Claims or action pursuant to remedies provided by law for Claims between Owner and Contractor, unless the Designer fails to timely comply with Section 15.2.2.

.§ 15.2.2 The Initial Decision Maker—Designer will review Claims and within ten days of the receipt of a Claim or information preliminary or pursuant to a Claim or modification to a Claim and take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker—Designer is unable to resolve the Claim if the Initial Decision Maker—Designer lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker—Designer concludes that, in the Initial Decision Maker—Designer’s sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim, the Designer to resolve the Claim. If Designer approves or rejects the Claim, parties have ten days to request reconsideration based upon additional information, or the decision shall be final. If Designer suggests compromise, parties have ten days to respond. If the Designer declines to resolve the claim, the Owner may, but is not obligated to, take the lead in resolving the Claim.

.§ 15.2.3 In evaluating Claims, the Initial Decision Maker—Designer may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker—Designer in rendering a decision. The Initial Decision Maker—Designer may request the Owner to authorize retention of such persons at the Owner’s expense.

.§ 15.2.4 If the Initial Decision Maker—Designer requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of such request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker—Designer when the response or supporting data will be furnished or (3) advise the Initial Decision Maker—Designer that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker—Designer will either reject or approve the Claim in whole or in part.
§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution to the provisions in Section 15.2.2, and thereafter to mediation if consented to by both parties, and to remedies as otherwise provided by law.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of an initial decision, demand in writing that the other party file for mediation within 60 days of the initial decision. If such a demand is made and the party receiving the demand fails to file for mediation within the time required, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor’s default, the Owner may, but is not obligated to, notify the surety and request the surety’s assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic’s lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines. As a matter of law, the State of Tennessee and its property are not subject to mechanic’s and material suppliers liens. Subcontractors, suppliers, and other claimants are protected through the Contract Bond as required by TCA § 12-4-201 et seq., the policies of the State Building Commission, and Section 11.4 of these Conditions. Specific requirements for notice of Claims on the bond are set forth in the TCA § 12-4-205.

§ 15.3 MEDIATION
The State of Tennessee is not subject to mandatory mediation.

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.6 shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 The parties shall share the mediator’s fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 ARBITRATION
The state of Tennessee is not subject to mandatory arbitration.

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party
- filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 CONSOLIDATION OR JOINDER
§ 15.4.4.1 Either party, at its sole discretion, may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Either party, at its sole discretion, may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as the Owner and Contractor under this Agreement.
Certification of Document’s Authenticity

AIA® Document D401™ – 2003

I, Dick Tracy, hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with this certification at 13:18:38 on 07/09/2009 under Order No. 1234567890_1 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A201™ – 2007 - General Conditions of the Contract for Construction, as published by the AIA in its software, other than changes shown in the attached final document by underscoring added text and striking over deleted text.

(Signed)

(Title)

(Dated)
SUPPLEMENTARY CONDITIONS

REGARDING ALL CONTRACTS USING OFD CONDITIONS FOR GENERAL WORK.

MODIFICATIONS TO
OFD s007213 for General Work
(a modified AIA Document A201-1997)

GENERAL CONDITIONS
OF THE CONTRACT FOR CONSTRUCTION

The following supplements modify, change, delete from or add to "General Conditions of the Contract for Construction", and any other Conditions preceding these by section number for this Contract. Where a portion of Conditions is altered by these Conditions, the unaltered portion shall remain in effect.

--------------------------- ARTICLE 1 ---------------------------

GENERAL PROVISIONS

1.1.4 The Project

Add to this section:
The Project is identified in the first page of the Agreement with an Owner’s project number in the format of 999/999-99-9999XX. This project number may differ from the number as used on other Contract Documents. This Owner’s project number is to be shown in all correspondence related to the project.

--------------------------- ARTICLE 3 ---------------------------

CONTRACTOR

3.4.7 Prevailing Wage Scale:
Delete this section in its entirety.

Add the following section:
3.22 Financial Records:

3.22.1 The Contractor shall maintain documentation for all charges under this Contract. The books, records, and documents of the Contractor, insofar as they relate to work performed or money received under this contract, shall be maintained for a period of three (3) full years from the date of the final payment and shall be subject to audit at any reasonable time and upon reasonable notice by the State, the Comptroller of the Treasury, or their duly appointed representatives. The financial statements shall be prepared in accordance with generally accepted accounting principles.

--------------------------- ARTICLE 9 ---------------------------

PAYMENTS and COMPLETION

9.10.6 Add: “If there is no Contract Bond, the final Certificate may be withheld until the prospect of final payment is advertised 30 days for the benefit of those to whom the Contractor may be indebted.”

--------------------------- ARTICLE 11 ---------------------------

INSURANCE and BONDS

11.1.5 Delete “other than to the Work itself”.

Add the following section:
11.1.6 Builder’s Risk Insurance (BRI) for the full amount of the Contract Sum, unless the Work consists entirely of hazardous materials abatement or other demolition with no constructive patching or renovating, in which case there will be no BRI.

11.3.1 Delete first sentence and substitute:
“The Contractor shall purchase from and maintain, with a company or companies licensed to do business in Tennessee by the Department of Commerce and Insurance, property insurance written on a builder’s risk “all risk” or equivalent policy form in the amount of the initial Contract Sum plus value of subsequent Contract modifications for the covered project at the site on a replacement cost basis.”

11.3.2 At beginning of first sentence delete “The Owner shall purchase…” and substitute “The Contractor shall purchase…”.

11.3.6 Substitute all references to “Owner” with “Contractor”, and substitute all references to “Contractor” with “Owner”.

11.3.8 Delete clause.

11.3.9 At the end of the section delete all after “shall be performed by the Contractor”.

END OF SECTION
SECTION 01 11 00 – SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Work covered by the Contract Documents.
   2. Type of Contract.
   3. Work under other contracts.
   4. Owner-furnished products.
   5. Contractor's use of premises.
   6. Owner's occupancy requirements.
   7. Work restrictions.

B. Related Sections include the following:
   1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: ETSU CoM Building #60 Interprofessional Education and Research Center

SBC 166/005-06-2013

B. Owner contact:

Tennessee Board of Regents

Keith King
Director of Project Management
Office of Facilities Development
Tennessee Board of Regents
1415 Murfreesboro Road, Suite 664
Nashville, TN 37217-2833

C. Architect: Red Chair Architects / 220 W. Jackson Avenue / Knoxville, TN 37902
   1. Architect or Record: David Cockrill, AIA
   2. Studio Director: Lisa Hoskins, AIA
   3. Project Management & Coordination: Patrick Core, AIA
D. The scope of the project includes a renovation of the existing historic Building #60 on the VA Memorial Campus in Johnson City, TN. The new design will implement a newly designed 38,567 square foot Interprofessional Education and Research space for East Tennessee State University.

The project’s program incorporates educational spaces, simulation labs, common areas, and administrative suites. New users will include the Colleges of Medicine, Pharmacy, Nursing, Clinical & Rehabilitative Health Sciences, and Public Health, in addition to small a Food Services component.

The existing four-story building was built around 1902 for use as a commissary and constructed of heavy timber beams and decking, heavy timber posts, and brick exterior walls. The central core of the building is cast-in-place concrete walls and floor slabs along with the stairs and elevator shaft, constructed as part of a renovation in 1942.

The existing exterior façade of the building is to be cleaned and maintained, with re-opening of most of the bricked-up historical openings. The existing slate roof will remain with some repair. The existing EPDM roof will be protected and with minor work including new penetrations per the Owner’s existing warranty requirements.

The existing interior stair is proposed to be reused as an open central stair, with the addition of two new rated egress stairs to be added inside both ends of the building. The existing elevator shaft will be utilized and possibly expanded for a new elevator, but the existing elevator equipment will be removed.

The structural deterioration of a cast-in-place concrete platform on the rear of the building, which was originally used as a loading dock for an adjacent rail line, is slated for demolition and replacement in a similar configuration with new structure. Additionally, extensive structural work and excavation will be required in the basement area to provide for a proposed 90-seat lecture hall.

The building will be serviced by a new centralized HVAC system including campus plant steam and a dedicated 125-ton chiller. Air handling and temperature control with utilize a combination of central air handling with zone VAV boxes and a central ventilation system with zone-dedicated fan coils. Plumbing systems will be completely replaced, as well as a renovation to the wet pipe sprinkler system. Additionally, the project shall include new lighting, communications, fire alarm, and power distribution systems, with a new pad-mounted transformer near the building.

The VA campus is a National Historic Landmark, so the design has been reviewed by the State Historic Preservation Office. As such, every effort will be made to preserve historic materials, features, size, scale and proportion, in order to protect the integrity of the property and its environment.

1.4 TYPE OF CONTRACT

A. Project will be constructed under a single prime contract.

1.5 OWNER-FURNISHED PRODUCTS

A. Owner will furnish products indicated on the drawings. The Work includes providing support systems to receive Owner’s equipment and making plumbing, mechanical, and electrical connections.

1. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor.
2. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.
3. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner’s inspection.
4. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
5. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Contractor.
6. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.
7. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Architect noting discrepancies or anticipated problems in use of product.
8. Contractor is responsible for receiving, unloading, and handling Owner-furnished items at Project site.
9. Contractor is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
10. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.
11. Contractor shall install and otherwise incorporate Owner-furnished items into the Work.

1.6 COORDINATION

A. Prior to commencing construction, the Contractor will meet with the Owner’s representative and the Architect’s Office to coordinate construction schedules, site access, security, and any other activities affecting, or affected by this project.

1.7 CONTRACTORS USE OF PREMISES

A. General: Contractor shall have full use of premises for construction operations, including use of Project site, during construction period, unless noted otherwise on the drawings. Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project. Do not disturb portions of the site that are identified on the drawings not to be disturbed.

1.8 OWNER'S OCCUPANCY REQUIREMENTS

A. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy completed areas of the site, before overall Substantial Completion. Such occupancy shall not constitute acceptance of the total Work.
1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.

1.9 WORK RESTRICTIONS

A. Non-smoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor air intakes.

1.10 SAFETY

A. The Contractor shall at all times maintain a safe work environment for employees and others occupying the site.
B. The Contractor is solely responsible for all safety matters, including the establishment and implementation of safety programs.
PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 11 00
PART 1 - GENERAL

1.01 SUMMARY

A. SECTION INCLUDES administrative and procedural requirements applicable to unit prices either established in these specifications or established in the Agreement based upon Owner’s solicitation and Contractor's bid. Solicited unit prices are subject to determination at the time of a change in the Work if the bid unit price was not accepted and not listed in the Agreement. Unit prices may also be established and added to these specifications by appropriate Modification.

B. RELATED SECTIONS are referenced in the definition of each unit price item. Unit Price items are listed in Section 01 22 15.

C. INVALID UNIT PRICES: If no Base Quantity is stipulated, or if the Base Quantity is zero, then the unit price is invalid.

D. INCLUSIONS: Unit Prices include all direct and indirect costs, except overhead and profit, associated with the unit price item, and are treated as direct prices to the Owner by the Contractor, regardless of whether the work of the unit price item is being performed by a subcontractor or a sub-subcontractor.

E. ALLOWANCE: Each Unit Price multiplied by its Base Quantity constitutes an allowance included in the Contract Sum.

1.02 ADMINISTRATION

A. Represent the allowance for each unit price item as a distinct line item in the Schedule of Values.

B. Keep a daily log of actual quantities of specified work units encountered, consumed, or expended. When submitting an application for payment which includes payment for Unit Price items, provide Designer a copy or report of the log which is acceptable to Designer. Actual quantities and the Contractor's log are subject to verification by Designer.

C. ADJUSTMENT OF COSTS

1. Continuously monitor the consumption of each Base Quantity and the associated use of the allowance and the anticipated use to complete the Work. Do not exceed an allowance.

2. If a Base Quantity and the associated allowance are at risk of being exceeded, request a modification to increase them in a timely manner to avoid delay in the Work.

3. If all of the Work of an allowance is complete and there is unexpended allowance remaining, request a modification to decrease the allowance to equal the amount that has been used.

D. If adjustments exceed, or are expected to exceed, a cumulative twenty five percent (25%) of the initial Base Quantity, either party to the Contract may initiate renegotiation for a new unit price. Such a new unit price shall be made a part of the Contract by appropriate Modification.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES the list of Unit Price items, and applicable established Unit Prices. Solicited unit prices are denoted in the “Definitions” Article below by having “(S)” as the Unit Price per Unit. Refer to Section 01 22 13 for general administrative requirements.

1.02 DEFINITIONS for each Unit Price item are as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Related Sections</th>
<th>Base Quantity</th>
<th>Unit</th>
<th>Unit Price per unit</th>
<th>Work Included</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31 20 00</td>
<td>5</td>
<td>CU YD</td>
<td></td>
<td>Rock Removal and replacement with controlled low strength material</td>
</tr>
<tr>
<td>2</td>
<td>31 20 00</td>
<td>5</td>
<td>CU YD</td>
<td></td>
<td>Rock removal and replacement with suitable compacted soil backfill</td>
</tr>
<tr>
<td>3</td>
<td>31 20 00</td>
<td>5</td>
<td>CU YD</td>
<td></td>
<td>Rock removal and replacement with compacted crushed stone backfill</td>
</tr>
<tr>
<td>4</td>
<td>31 20 00</td>
<td>5</td>
<td>CU YD</td>
<td></td>
<td>Unsuitable soil removal and replacement with controlled low strength material</td>
</tr>
<tr>
<td>5</td>
<td>31 20 00</td>
<td>300</td>
<td>CU YD</td>
<td></td>
<td>Unsuitable soil removal and replacement with suitable compacted soil backfill</td>
</tr>
<tr>
<td>6</td>
<td>31 20 00</td>
<td>5</td>
<td>CU YD</td>
<td></td>
<td>Unsuitable soil removal and replacement with compacted crushed stone backfill</td>
</tr>
<tr>
<td>7</td>
<td>04 03 23</td>
<td>1,400</td>
<td>FT</td>
<td></td>
<td>Miscellaneous re-pointing of masonry (in addition to specific areas of re-pointing indicated on drawings)</td>
</tr>
<tr>
<td>8</td>
<td>01 35 91</td>
<td>50</td>
<td>TILES</td>
<td></td>
<td>Replacement of loose/damaged roof tile from owner’s existing stock</td>
</tr>
<tr>
<td>9</td>
<td>06 03 12</td>
<td>500</td>
<td>CU IN</td>
<td></td>
<td>Restoration of wood rafters and brackets at soffits (in addition to specific areas of epoxy restoration shown on drawings)</td>
</tr>
<tr>
<td>10</td>
<td>07 01 50.19</td>
<td>10</td>
<td>BOARD FT.</td>
<td></td>
<td>Replacement of existing damaged wood roof blocking and deck pieces with equal wood board materials.</td>
</tr>
</tbody>
</table>
PART 1 - GENERAL

1.01 SECTION INCLUDES identification of each Alternate by number, and describes the basic changes to be incorporated into the Work if a particular alternate is made a part of the work by specific provisions in the Agreement between the Owner and the Contractor.

1.02 RELATED SECTIONS are referenced in the definition of each Alternate.

1.03 COORDINATION of related work and modifications to surrounding work as required to properly integrate each Alternate, and to provide the complete construction required by the Contract Documents, is the responsibility of the Contractor.

1.04 DESCRIPTION OF ALTERNATES:

Alternate #1 - Refer to ES100 and E003. Replace existing 15kV S&C Vista (3-Way) "SW7" with new 15kV S&C Vista (4-Way) Switch. Coordinate Building #178 and Campus outages with Campus authorities. Re-work existing 600A in/out circuits to new switch, existing 200A Building 178 circuit, and new Building #60 200A circuit to new switch. See Electrical Alt. #1 15kV one-line diagram and details on E003 for more information.
PART 1 - GENERAL

1.01 SUBSTITUTIONS:

A. Substitute products should not be ordered and shall not be installed without written approval or acceptance from Designer. Contractor assumes all risks associated with premature ordering and installation of substitute products.

B. The specifically named manufacturers, products, and systems, and descriptive characteristics used in the Contract Documents normally serve only to establish a level of quality and a performance standard. Unless specific restriction is placed upon an item in the specifications, Contractor may submit proposals for substitutions. The Owner reserves the right to disallow substitutions. Contractor assumes risks associated with possible rejection of proposals for substitution submitted during the life of the contract.

C. Delays caused by tardiness of Contractor in preparing and forwarding submittals do not constitute an acceptable basis for consideration of substitute products. Delays due to factors which were in effect prior to project bidding do not constitute an acceptable basis for consideration of substitute products.

1.02 SUBSTITUTION REQUEST FORM:

A. Requests for substitutions shall be submitted to Designer on the form exhibited as Section 01 25 33, or in a similar format which provides the same or more information.

B. When making requests for substitutions, Contractor assumes the following responsibilities:
   1. To have personally investigated the proposed substitute product and determined it is equal or superior in all respects to that specified;
   2. To provide the same warranty for substitute that Contractor would for that specified;
   3. To provide complete cost data, and waive all claims for additional costs related to substitution which subsequently become apparent; and
   4. To coordinate installation of the accepted substitute, making such changes as may be required for Work to be complete in all respects.

END OF SECTION
To:  

Attn:  

Specified Item:  

Project:  

Proposed Substitute:  

1. The following are attached (Mark all that apply):
   - Complete Description
   - Laboratory Tests
   - Catalog
   - Spec Data
   - Information on the availability of maintenance services and replacement materials for proposed substitute(s)
   - Names, addresses, and phone numbers of fabricators and suppliers for proposed substitute(s)

2. This substitution will have the following effects on dimensions, gauges, weights, etc.:

3. This substitution will have the following effects on wiring, piping, ductwork, etc.:

4. This substitution will have the following effects on other trades:

5. This substitution will have the following effect on construction Schedules:

6. The proposed substitute(s) differs from the specified product(s) in quality and performance as follows:

7. Manufacturers guarantees for the substitute(s) and the specified product(s) are (check one):
   - the same
   - different (if different, explain below)
8. If the proposed substitution is accepted, it will result in:
   - no cost impact
   - a cost increase of  
   - a cost decrease of

   (If change in cost is indicated, itemization on specified Cost Itemization Form is attached)

9. License fees or royalties are pending on the proposed substitute.
   - No
   - Yes (if yes, explain below)

10. The undersigned or the firm represented shall pay for additional studies, investigations, submittals, redesign, and analysis by the Designer necessitated by this substitution request.

   Substitutions must be requested in accordance with applicable Contract requirements. After bidding, substitutions are to be submitted only by Contractor. Substitute products should not be ordered or installed without written acceptance.

Submitted by:
   - Name:
   - Telephone:
   - for:
   - Name of firm:

Address:
   - Street address:
   - and mailing address:
   - if different:
   - City, State, and Zip Code:

Designer’s Review Comments:
   - Accepted
   - Accepted as noted
   - Rejected
   - Rejected (received too late)
   - Rejected (submittal incomplete)

   Additional comments:

For the Designer:
   - Signature here: ____________________________
   - Date: ____________________________
PART 1 - GENERAL

1.01 SUPPORTING DOCUMENTATION for PROPOSALS or CLAIMS


B. For a change in the Work, specifically describe proposed change, or briefly describe the proposed change with specific reference to a completely descriptive attachment, such as a Request for Proposal from the Designer.

C. For a change in Contract Sum, state briefly the reason for change, state the amount, and provide itemization of values on the following forms, or similar forms providing the same information:
   1. Section 01 26 54 Form for Price Summary: listing the itemizations of work by subcontractors and the Contractor that together apply to an entire related change in work.
   2. Section 01 26 55 Form for Price of Work: detailing the quantities, units, costs, and extensions for materials, equipment, and labor, subtotaled, plus overhead, and profit related to a specific proposed change in the Work.
   3. Section 01 26 56 Form for Price of Time: if applicable, deriving an average cost per day.

D. For a change in Contract Time:
   1. Fully describe the extent of and reasons for the change and effect of the change on the construction schedule, and attach a revised Progress Schedule. Take into account weekends, holidays, and the specified standard baseline for weather delays during the period of the requested extension.
   2. For a change based on weather-related delay, provide and attach:
      a. applicable specified Weather Delay Reports, or, if none is specified, daily work logs that describe actual local weather conditions and their impact on progress.
      b. National Oceanic and Atmospheric Administration (NOAA) weather data, for corroboration.
      c. NOAA comparative data on normals, means, and extremes if such data or another weather baseline is not already provided in Contract Documents.

1.02 SIGNATURES for Change Order:

A. Form shall be similar in format and content to Section 01 26 40, and signed by authorized representatives of each of the entities required by Conditions of the Contract.

B. Normal procedure shall be that:
   1. Designer prepares and submits supporting documents to Owner.
   2. Owner produces and signs three (3) counterparts of form; transmits by fax, e-mail, or other means, informational copies to its Construction Representative, Designer, and Contractor; and forwards.
   3. Owner’s Construction Representative receives counterparts, and brings them to next Progress Meeting, unless urgency and opportunity make for a more timely execution.
   4. Designer and Contractor both sign all three (3) counterparts at Progress Meeting. Each retains a counterpart, and the Owner’s Construction Representative retains the third for the Owner.

END OF SECTION
PART 1 - GENERAL

1.01 EXTENSIONS OF CONTRACT TIME

A. If the basis exists for an extension of time in accordance with paragraph 8.3 of the Conditions, an extension of time on the basis of weather may be granted only for the number of Weather Delay Days in excess of the number of days listed as the Standard Baseline for that month.

1.02 STANDARD BASELINE FOR AVERAGE CLIMATIC RANGE

A. The Owner has reviewed weather data available from the National Oceanic and Atmospheric Administration and determined a Standard Baseline of average climatic range for the State of Tennessee.

B. Standard Baseline shall be regarded as the normal and anticipatable number of calendar days for each month during which construction activity shall be expected to be prevented and suspended by cause of adverse weather. Suspension of construction activity for the number of days each month as listed in the Standard Baseline is included in the Work and is not eligible for extension of Contract Time.

C. Standard Baseline is as follows:

```
Jan  12  Feb  11  Mar  8  Apr  7  May  7  Jun  6  Jul  7  Aug  5  Sep  4  Oct  5  Nov  6  Dec  11
```

1.03 ADVERSE WEATHER and WEATHER DELAY DAYS

A. Adverse Weather is defined as the occurrence of one or more of the following conditions which prevents exterior construction activity or access to the site within twenty-four (24) hours:

1. precipitation (rain, snow, or ice) in excess of one-tenth inch (0.10") liquid measure

2. temperatures which do not rise above 32 degrees F by 10:00 a.m.

3. temperatures which do not rise above that specified for the day's construction activity by 10:00 a.m., if any is specified

4. sustained wind in excess of twenty-five (25) m.p.h.

5. standing snow in excess of one inch (1.00")

B. Adverse Weather may include, if appropriate, "dry-out" or "mud" days:

1. for rain days above the standard baseline;

2. only if there is a hindrance to site access or sitework, such as excavation, backfill, and footings; and,

3. at a rate no greater than 1 make-up day for each day or consecutive days of rain beyond the standard baseline that total 1.0 inch or more, liquid measure, unless specifically recommended otherwise by the Designer.

C. A Weather Delay Day may be counted if adverse weather prevents work on the project for fifty percent (50%) or more of the contractor's scheduled work day, including a weekend day or holiday if Contractor has scheduled construction activity that day.
1.04 DOCUMENTATION and SUBMITTALS

A. WEATHER DELAY REPORT:

1. Use a copy of Section 01 26 25 as a Weather Delay Report, indicating for each calendar month the days on which construction activity affecting the critical path of the Work was prevented by weather conditions.

2. In the column for the cause, indicate measurement of precipitation, temperature, wind, or other influencing factors.

3. Describe the construction activity that was scheduled, on the critical path, and delayed.

4. At the end of the month, add up the number of days delay, subtract the baseline number given in this Section, and show the resulting claimable days in excess of baseline.

5. Submit a copy of the completed report with the next application for payment. Reports submitted with applications for payment do not constitute a claim or preliminary claim for extension of time.

B. When making a claim for a time extension based on weather delay(s):

1. Submit a copy of all reports completed since the last month for which a time extension was previously claim, or the commencement of Work if no previous claim, through the last month for which delay is being claimed. Claims for time extension based upon weather delays are unjustified if a submitted report does not corroborate the claim or if no report was submitted when it was required with an application for payment.

2. Submit daily jobsite work logs showing which and to what extent construction activities have been affected by weather on a monthly basis.

3. Submit actual weather data to support claim for time extension obtained from nearest NOAA weather station or other independently verified source approved by Designer at beginning of project.

4. Organize claim and documentation to facilitate evaluation on a basis of calendar month periods, and submit in accordance with the procedures for Claims established in Article 15 of the Conditions, and the applicable General Requirements.

5. If an extension of the Contract Time is appropriate, it shall be implemented in accordance with the provisions of Article 7 of the Conditions, and the applicable General Requirements.

END OF SECTION
<table>
<thead>
<tr>
<th>Date</th>
<th>Weather Condition Causing Delay</th>
<th>Work Scheduled on Critical Path for This Day That Was Delayed</th>
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</thead>
<tbody>
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<td></td>
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<tr>
<td>25</td>
<td></td>
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<tr>
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<td>27</td>
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<td></td>
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<tr>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total number of days this month with delay due to weather

Baseline number from Section 01 26 20

Total – Baseline = claimable days
SECTION 01 26 40  
FORM FOR AMENDMENT, CHANGE ORDER, OR DIRECTIVE

[ ] Amendment  
[ ] Change Order  
[ ] Construction Change Directive

Modification Number: PROJECT:

Original Contract Date:  
This Change initiated:  
Project Number

The following changes in the Contract are hereby directed:

<table>
<thead>
<tr>
<th>Item</th>
<th>Reference</th>
<th>Work</th>
<th>Contract-Sum</th>
<th>Contract-Time</th>
</tr>
</thead>
</table>

The original Contract Sum ................................................................. $
Net Change previously authorized .......................................................... $
The Contract Sum prior to this Modification ................................................. $
This modification ( increases / does not change / decreases ) the Contract Sum .... $
The new Contract sum, including this modification ........................................ $
This modification ( increases / does not change / decreases ) the Contract Time ....
The new Contract Time, including this modification ....................................... 
The last day of the Contract Time, including this modification .........................

**CONTRACTOR**
Signed
Name & Date
For

**DESIGNER**
Signed
Name & Date
For

**OWNER**
Signed
Name & Date
For
### SECTION 01 26 54

**FORM FOR PRICE SUMMARY**

<table>
<thead>
<tr>
<th>SBC Project Number</th>
<th>Project Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name of General contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proposal Number</th>
<th>Date Itemized</th>
<th>Page of pages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Work by Subcontractors</th>
<th>Name of Subcontractor</th>
<th>Costs and Allowances</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subtotal</th>
<th>General Contractor mark-up on Subtotal: %</th>
<th>=</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td></td>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subtotal for General Contractor for work by subcontractors:</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Work by General Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subtotal (including Subcontractors and the General Contractor):</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bond Premium</th>
<th>%</th>
<th>=</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.00</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Total:</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
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</tbody>
</table>

Cells with red underline (if viewed in color) are for you to fill in. Others are protected.

Rounding off is permitted if rounding up for decreases and rounding down for increases. Math functions in XLS show rounded to nearest penny, but carry exact value for calculations. Let embedded math do its work.

This XLS spreadsheet is available on Owner's website, Designers' Manual, Bidding Documents, listed by its Section number and title.
### SECTION 01 26 55
#### FORM FOR PRICE OF WORK

<table>
<thead>
<tr>
<th>Description</th>
<th>Material</th>
<th>Equipment</th>
<th>Labor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quantity</td>
<td>Unit</td>
<td>Cost</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>0.00</td>
</tr>
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<td></td>
<td></td>
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<td>0.00</td>
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</tr>
<tr>
<td></td>
<td></td>
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<td>0.00</td>
</tr>
</tbody>
</table>

**Materials** Subtotal 0.00

<table>
<thead>
<tr>
<th>Percentage Sales Tax =</th>
<th>0.00</th>
</tr>
</thead>
</table>

**Equipment** Subtotal 0.00

<table>
<thead>
<tr>
<th>Percentage Burden =</th>
<th>0.00</th>
</tr>
</thead>
</table>

**Labor** Subtotal 0.00

<table>
<thead>
<tr>
<th>Cost:</th>
<th>0.00</th>
</tr>
</thead>
</table>

Subtotal of Costs of Materials + Equipment + Labor = $ 0.00

10% Overhead allowed on costs = $ 0.00

Subtotal of Costs + Overhead = $ 0.00

5% Profit allowed on Costs + Overhead = $ 0.00

Total for this change = $ 0.00

---

Cells with red underline (if viewed in color) are for you to fill in. Other cells are protected. Rounding off is permitted if rounding up for decreases and rounding down for increases. Math functions in XLS show rounded to nearest penny, but carry exact value for calculations.

Let embedded math in "extension" columns do its work.

This XLS spreadsheet is available on Owner's website, Designers' Manual, Bidding Documents, listed by its Section number and title.
<table>
<thead>
<tr>
<th>Description</th>
<th>Period Cost</th>
<th>Period Cost</th>
<th>Cost Per Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superintendent Salary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Superintendent Vehicle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Use Vehicles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Office</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Office Equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fax Machine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copier</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typewriter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calculator</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Office Utilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Gas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Service</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drinking Water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telephone Service</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-Site Storage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trailer</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Safety Program</td>
<td></td>
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<tr>
<td>Cleaning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site Toilet(s)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Subtotal of Costs:  

10% for Overhead:  

Subtotal with Overhead:  

5% for Profit:  

Total per day:
SECTION 01 29 16
CM/GC-GMP CONTINGENCY AND RESERVE

PART 1 - GENERAL

1.01 DEFINITION

A. The CM/GC-GMP Contingency and the Reserve Fund are defined in the CM/GC Master Contract Attachment 1 Scope of Services and Deliverables.

B. The CM/GC-GMP Reserve Fund is an accumulation from trades that were estimated at the time that the GMP was agreed upon and are later bid to complete the trade bidding. Trades that bid less than estimated add the difference to Reserve. Trades that bid more than estimated deduct the difference from Reserve. Once all estimated trades are bid and awarded, if there is a net negative Reserve, the amount is charged to the GMP Contingency, regardless whether the GMP Contingency has sufficient balance to cover the charge. The Reserve does not accumulate from savings through substitutions, reductions in Work, nor unused remainders of allowances; rather, such savings are to be returned to the Owner through an appropriate modification as soon as they occur.

1.02 CM/GC-GMP CONTINGENCY LOG

A. Maintain a Contingency Log on the specified form, showing for each item a sequence number, brief caption description, individual cost, the portion of that cost currently incurred for Total Completed and Stored to Date of applications for payment, and whether the item needs or has received concurrence required by 1.02.C. If there are Phases, make sequence numbering subordinate to each Phase, grouping the items by Phase, and provide a subtotal for each Phase.

B. Providing a copy of Log to Owner and Designer constitutes written advisement for items clearly fitting definition.

C. When providing an updated Log that contains items not clearly fitting Contingency definitions that have not been given written concurrence by Owner and Designer accepting the inclusion in the Contingency, identify such items and obtain written concurrence from Designer and Owner in the form of their initials upon a copy of the Log next to each such item.

1.03 RESERVE FUND LOG

A. Maintain a Reserve Fund Log on the specified form, showing for each estimated trade:
   1. the Name of the successfully bidding subcontractor engaged for the trade, once trade bidding is actually completed. Until then, while trade bidding is pending, leave the subcontractor blank;
   2. the Date for trade bidding, whether pending a future occurrence, or actually having occurred; or, when an exception to trade bidding has been authorized by the Owner, the date of authorization;
   3. the Description of the trade, and, if the amount of the trade is split between multiple line items in the schedule of values, the line items of the Schedule of Values that together account for the full amount of the trade;
   4. the Estimated Value of the trade as agreed;
   5. the Actual Price of the trade, once trade bidding has actually occurred and subcontracts awarded based upon bidding; and,
   6. the Effect on Reserve, which is the Estimated Value minus the Actual Price.

B. The Reserve Log spreadsheet calculates the Effect on Reserve once a Name is filled in. This formula is filled in for enough rows to fill most or all of the first page. If the Log requires further rows, copy the formula into the additional rows.

C. List the estimated trades in the order they are listed in the agreement and amendments, if any.

D. As trade bidding is completed for each trade, report the results, identifying the trade(s) procured, and providing an updated copy of the Reserve Log, bid tabulation, and a copy of the bids received.
E. Except as may be allowed according to paragraph F immediately below, if an estimated trade is not procured by bidding, it loses its status as an estimated trade and instead becomes a scope gap to be paid from the GMP Contingency. In this case, enter this in the Reserve Log with “scope gap” as the Subcontractor, the effective date as the Date, the Description unchanged, the Estimated Value unchanged, zero as the Actual Price, and the resulting increase Effect on Reserve.

F. Owner may authorize an exception to the requirement of bidding a trade when: the trade is a relatively small add to an existing subcontracted trade; or, if the trade is relatively small and impractical to procure through bidding; or, if the trade has been specified as proprietary or sole-source; or, if the trade is work that can only be provided by a local utility or government. In such exceptional cases, the CM/GC will provide an itemized cost for that trade using specification section 01 26 55; or, if a local utility or government, then whatever is their customary means of presenting their costs.

G. If Owner authorizes a transfer of Reserve into Contingency, enter this in the Reserve Log with the name of the Owner employee authorizing the transfer as the Subcontractor, the authorization date as the Date, “Owner authorized transfer” as the Description, zero as the Estimated Value, the amount of authorized transfer as the Actual Price, and the resulting decrease Effect on Reserve.

H. Attach current copy of Reserve Log to each counterpart of each Application for Payment.

1.04 EFFECT ON THE SCHEDULE OF VALUES

A. Include only values consistent with the current Contingency Log and Reserve Log. To the extent that 1.02.C requires concurrence for items, include only values consistent with concurrences received.

B. Include a single line item in the Schedule of Values for the Reserve Fund. If there are no phases in the Schedule of Values, include a single line item in the Schedule of Values for the CM/GC-GMP Contingency, and represent values as for other line items.

C. If there are Phases in the Schedule of Values:
   1. include an overall line item for the portion of the CM/GC-GMP contingency not included in a Phase;
   2. include also a line item in each Phase for its portion of the CM/GC-GMP contingency;
   3. initially, set CM/GC-GMP contingency values at full value for overall, and zero for each phase;
   4. as costs are assigned to CM/GC-GMP Contingency, to the extent costs are applicable within phases, increase scheduled value of applicable Phase, and reduce scheduled value of overall CM/GC-GMP contingency, so their sum remains constant; and,
   5. represent values for each CM/GC-GMP contingency line item as for other line items.

D. Include estimated trades as distinct line items in the Schedule of Values, initially showing these at their Estimated Value, later adjusting them to their Actual Price as the trade bidding is completed.

1.05 EFFECT ON APPLICATIONS FOR PAYMENT:

A total completed and stored to date for an estimated trade cannot be included in an application for payment until the procurement has been completed and the effect on Reserve shown in the Reserve Log.

1.06 EFFECT ON PROGRESS SCHEDULE AND PUBLIC ADVERTISEMENT:

A. In the Progress Schedule, show the bid dates for each estimated trade as also shown in the Reserve Log. In the Progress Schedule, include the period during which the trade will be released for solicitation of its trade bids.

B. Inform the Owner’s bidding coordinator specifically when each trade enters solicitation, and ensure that the bidding coordinator has posted the public advertisement for the suitable period approved by the Owner’s project manager.

END OF SECTION
### Form for CM/GC GMP Contingency Log

<table>
<thead>
<tr>
<th>Date</th>
<th>Credit</th>
<th>Charge</th>
<th>Remaining Contingency</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
<td></td>
</tr>
</tbody>
</table>

*Posted in XLS format*

*General Work for CM/GC*

*March 2012 OFD s012917 page 1 of 1*
### SECTION 01 29 18
FORM FOR CM/GC GMP RESERVE FUND LOG

<table>
<thead>
<tr>
<th>Name</th>
<th>Date</th>
<th>Description</th>
<th>Estimated Value</th>
<th>Actual Price</th>
<th>Effect on Reserve</th>
</tr>
</thead>
</table>

Current Reserve: 0.00

Reserve Fund Log
01 29 18 - 1
PART 1 - GENERAL

1.01 Basic Requirements

A. Retainage escrow requirements are mandated by Chapter No. 340 House Bill No. 966 Public Acts of 1985 which was passed by the Tennessee General Assembly.

B. Conditions of Contract, in accordance with State law, require retainage to be deposited into an interest-bearing escrow account if the Contract Sum $500,000 or greater. Compliance is mandatory and cannot be waived.

C. Failure to have the escrow account operational by the time of the contractor’s second application for payment can result in delay of payment or inability of the Owner to make payment. Any such delay or inability to pay will not be grounds for relief under the prompt payment statutes.

1.02 The banking institution handling the retainage escrow account must be in an appropriate custodial care agreement with the State Treasurer. If not already in such an agreement, a banking institution can request such an agreement from the State Treasurer, subject to meeting eligibility requirements of TCA section 12-4-108(c).

1.03 Getting Started

A. Shortly after award of Contract, the Tennessee Department of Finance and Administration (F&A) will send the Contractor its latest information for starting the account. This information typically includes:

1. procedural guide
2. forms, including the basic application, colloquially referred to as “Form A”.
3. list of banks that currently have agreements with the State to host retainage escrow accounts

B. Getting help

1. The instructions from F&A will include a name and phone number to call for help:
   a. If the Contractor needs help completing Form A.
   b. If the Contractor plans to use a lending institution that does not have a current agreement with the State for hosting retainage escrow.

2. At the time this standard specification is written (see bottom left of page) the contact person for help in setting up new escrow accounts and completing Form A is Mary Mansour at (615)741-1317.

C. To avoid delays in setting up the escrow, and possible delays in payment, do not wait to be contacted by F&A as described above. Instead, if the Contract Sum is $500,000 or greater, as soon as the Contract is awarded, take the Form A that is page 2 of this Section, get it filled out and executed with the escrow bank, and have the bank send the original wet-signature Form to

   ATTN: Mary Mansour
   Tennessee Department of Finance and Administration
   Office of Business and Finance
   Suite 2000 William R. Snodgrass Tennessee Tower
   312 Rosa L. Parks Avenue
   Nashville TN 37243-0294

1.04 A sample of Form A is provided on page 2 of this Section. Otherwise, this is the …

END OF SECTION
FORM A
APPLICATION FOR THE SUBSTITUTION OF SECURITIES FOR ALL AMOUNTS RETAINED ON STATE BUILDING COMMISSION CONSTRUCTION CONTRACTS

Date: ________________________________

RE: Contract Number: __________________

Project No.: __________________

Location: ____________________________

Dear State Building Commission:

Pursuant to the provisions of Tennessee Code Annotated, Sections 12-4-108, Contractor’s name and address as appearing on construction Contract:

hereby requests that whenever payment for which certain amounts are retained by the State Building Commission as determined by the subject construction contract, the amount so retained be substituted for approved securities, as designated by the Tennessee State Treasurer.

The undersigned Contractor hereby appoints __________________________ (Name of Banking Institution)

located at ____________________________ (Complete Address of Banking Institution)

agent and attorney-in-fact to receive all amounts retained by the State Building Commission under the provisions of the subject construction Contract and to purchase Retainage Securities of the following type: ____________________________ (Description & Account Number)

The appointed Banking Institution, as indicated by the acceptance signature shown below, agrees to enter or has already entered into a Trust Agreement with the Tennessee State Treasurer to act as custodian and servicing agent of Retainage Securities and to perform all assigned duties and responsibilities with respect thereto as set forth in the Trust Agreement, which is herein incorporated by reference.

Very truly yours,

(Signature of Authorized Representative of Contractor) ____________________________ (Title)

ACCEPTED:

(Signature of Authorized Officer of Banking Institution) ____________________________ (Title)

CONTACT PERSON (BANK) ____________________________ PLEASE PRINT

PHONE NUMBER ____________________________
SECTION 01 29 73
SCHEDULE OF VALUES

PART 1 - GENERAL

1.01 RELATED SECTIONS

A. Phases are normally set forth in the Agreement and in the Summary of Work specification, normally from 01 10 00 to 01 10 19, but may differ in this Project Manual.

B. Applications for Payment and the final statement of accounting are normally specified in sections from 01 29 00 to 01 29 99, such as OFD standard Section 01 29 76, but may differ in this Project Manual.

C. Allowances are normally specified in sections from 01 21 00 to 01 21 99, such as OFD standard sections 01 21 13 and 01 21 15. Allowances associated with Unit Prices are normally in sections from 01 22 00 to 01 22 99, such as OFD standard sections 01 22 13 and 01 22 15. The arrangement of sections may differ in this Project Manual.

1.02 FORM and APPROVAL

A. The form for schedule of values shall be AIA Document G703 Continuation Sheet.

B. If objected to by Designer, revise and resubmit to Designer's satisfaction prior to submitting application for payment. If during construction, a line item's total completed and stored to date for payment purposes exceeds or is anticipated to exceed allocations, revise and resubmit a schedule of values such that no values of completed work exceed their allocations.

1.03 ALLOCATION OF VALUES

A. If the Work is divided into defined portions (“Phases”), intended to have distinct commencement, duration, or completion requirements, divide the allocation to correspond to the Phases, providing a sub-total for each Phase; then within each Phase, subdivide the allocations as specified in the following paragraphs.

B. Provide at least these three line items to account for General Requirements:
   1. Mobilization, staging, and general start-up costs.
   2. Construction administration and temporary facilities, prorated over the course of the project.
   3. Maintenance of Record Documents, prorated over the course of the project.

C. If sitework is included, other than minor sitework incidental to a building or major structure, include sitework in single line item or group of line items. Within the group, categorize site utilities, roads and parking, and appurtenances according to general type and physical separation. If allowances are stipulated in the Work relating to sitework, provide a line item for each such allowance, including quantity allowances associated with Unit Prices.

D. For each involved building or major structure:
   1. If allowances are stipulated in the Work, provide a line item in the Schedule of Values for each allowance, including quantity allowances associated with Unit Prices.
   2. If the Contract is a CM/GC contract based on a Guaranteed Maximum Price (GMP) with estimated trades identified as a part of the GMP, provide a distinct line item for each estimated trade.
   3. Categorize by major trades or units of work corresponding to the current Progress Schedule, and relate to the Divisions and Sections of the Specifications.
   4. Further subdivide as desired, but maintain a distinct and identifiable correspondence to this allocation.

E. Account for Modifications by incorporating them into the appropriate allocations, or with a line item for each, until incorporating each into the appropriate allocations for the final statement of accounting.

END OF SECTION
SECTION 01 29 76
APPLICATIONS AND CERTIFICATES FOR PAYMENT

PART 1 - GENERAL

1.01 SUBMITTAL:

A. In each application for payment, according to its context, provide:

<table>
<thead>
<tr>
<th>Counterpart or Copy</th>
<th>Progress Payment</th>
<th>Reducing Retainage upon SC</th>
<th>Final Payment</th>
<th>Document</th>
</tr>
</thead>
<tbody>
<tr>
<td>counterpart</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>G702 Application</td>
</tr>
<tr>
<td>copy</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>G703 Continuation</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>Final Accounting</td>
</tr>
<tr>
<td>copy</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>Contingency &amp; Reserve Logs (if CM/GC)</td>
</tr>
<tr>
<td>copy</td>
<td>if any</td>
<td>if any</td>
<td>no</td>
<td>Off-Site Stored Materials documents</td>
</tr>
<tr>
<td>counterpart</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>Affidavit of Payment</td>
</tr>
<tr>
<td>counterpart</td>
<td>no</td>
<td>YES</td>
<td>YES</td>
<td>Insurance Certificate</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>Statement of continuing insurability</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>if any</td>
<td>if any</td>
<td>U&amp;O permit</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>YES</td>
<td>YES</td>
<td>Data Binder Receipt(s)</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>Roof Warranty or warranties</td>
</tr>
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<td>Report of Subcontractors and Suppliers</td>
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<td>Visitor Log</td>
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<td>Weather Delay Report</td>
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<td>YES</td>
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<td>Progress Schedule</td>
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<td>copy</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>Submittal Log</td>
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B. Provide application documents assembled in order listed above, on 8½" x 11" pages, except 11" x 17" pages can be used for Progress Schedules and Submittal Logs if folded to fit an 8½” x 11” size. Orient all pages as shown below. Provide application sets bound with a single clip (no staple) affixed to the upper left of the G702 first page (according to its orientation).  

C. Counterpart documents shall be original instruments with wet signatures and embossed or wet-stamped seals, in each set of application documents.

D. Provide a draft submission, including attachments, as a PDF attached to an email, to Designer and to the Owner’s construction representative three (3) days prior to actual submittal.

E. Provide actual submission of five (5) sets of the application documents to the Designer at Progress Meeting, Substantial Completion inspection meeting, or final inspection meeting. If submitted outside of these meetings, provide conveyance of application to Designer, from Designer to Owner’s construction representative, and from Owner’s construction representative to Owner’s central office.
1.02 INCLUSIONS AND CALCULATIONS:

A. Accurately represent all values with two decimal places, calculated to the penny.

B. STORED MATERIALS: those suitably stored on-site but not yet incorporated into the Work can be included; and, those suitably stored off-site can be included if documented in accordance with later provisions of this Section.

C. On CM/GC contracts, the total completed and stored to date for estimated trades can only be included once bids have been taken, subcontracts awarded, and the actual price reconciled to the Reserve Log.

D. Calculation of Retainage and amounts withheld:
   1. Credit for completed work and stored materials, and deductions for incomplete work, comprise the “Total Completed and Stored to Date”. The “Total Completed and Stored to Date” shall not include the value of Punch List items that remain incomplete after Substantial Completion.
   2. Retainage is calculated as a percentage of “Total Completed and Stored to Date”: 5% prior to Substantial Completion; 2% after Substantial Completion; then, none at final payment. In the continuation sheets, showing retainage at individual line items is not required and is discouraged, as it promotes rounding errors. Retainage should only be shown at Phase sub-totals, if Phases exist, and when retainage rates vary between phases.
   3. Other amounts withheld (i.e., potential liquidated damages or in response to subcontractor claims of non-payment) can be added to the continuation sheet and deducted from the Total Completed and Stored to Date, or can be deducted from the resulting Current Payment Due after retainage and prior payments are accounted.

E. If a billing period would cross a State fiscal year (ending June 30, starting July 1), provide separate pay requests for the portion of work performed in each fiscal year.

1.03 FORMS, FORMAT, and CONTENT:

A. G702 Application: Use AIA Document G702 Application and Certificate for Payment
   1. For Project identification, include the Owner’s project number featured prominently, institution name, and work name, which is normally the Project title shown in the Agreement.
   2. Provide a unique, sequential application number.
   3. Include the Contractor’s address exactly as provided in the ACH Form.
   4. Show the County where the Work is located, normally where AIA captions “Contract for”.

B. G703 Continuation: Use AIA Document G703 Continuation Sheet itemized with the line items and values of the Schedule of Values accepted by Designer, and values and percentages for each line item. If there are Phases, include a sub-total for each Phase as well as a grand total.

C. Final Accounting: Allocate final Contract Sum as if modifications had been fully incorporated in Contract Sum at award of Contract, and shall follow the same format as the Schedule of Values.

D. GMP Contingency Log and Reserve Log, only if a CM/GC contract.

E. Off-Site Stored Materials: If any, provide:
   1. Statement identifying where materials are stored, and assuring that materials are tagged to identify them for use in the project.
   2. Bill(s) of sale for materials claimed that list(s) all items.
   3. Certificate of insurance covering materials claimed, recognizing Owner’s right to make claims.

F. Affidavit of Payment of Debts and Claims: Provide counterpart using AIA Document G706, when requesting final payment for the Work or reduction of retainage to zero for any portion of the Work.
G. Consent of Surety:
   1. If seeking reduction in retainage prior to Final Payment for the entire Work, or final payment on only a portion of the Work, provide counterpart using AIA Document G707A Consent of Surety to Reduction in Retainage, or a similarly formed letter.
   2. If seeking Final Payment, provide counterpart using AIA Document G707 Consent of Surety Company to Final Payment, or a similarly formed letter.
   3. If Contractor has listed exceptions in the Affidavit of Payment, Surety’s consent shall acknowledge such exceptions.
   4. If Contract is not bonded, Consent of Surety is not required, and Owner will instead advertise a public notice of settlement, and wait 30 days for responses, before accepting the application.
   5. Provide counterpart of Power of Attorney with Consent of Surety.

H. Insurance Certificate: If seeking final payment, provide certificate of insurance for products and completed operations as required by Conditions of the Contract sections 9.10.2(2) and 11.1.2.1.c.

I. Statement of continuing insurability: if seeking final payment, a letter written to the effect required by Conditions of the Contract section 9.10.2(3).

J. Use & Occupancy Permit (some jurisdictions have a different name): provide copy with first application following substantial completion.

K. Data Binder Receipt:
   1. with first application following substantial completion, provide copy of document identifying to whom Contractor delivered the Operating and Maintenance Data Binders.
   2. with application for final payment, provide copy of document identifying to whom Contractor delivered Project Data Binders

L. Roof Warranty or warranties, if any required on the Owner’s Section 07 50 35 standard form.

M. Report of Subcontractors and Suppliers, on the standard form.

N. Visitor Log for the period covered by application. After substantial completion, provide Log(s) for periods prior to substantial completion that have not been provided in a prior application.

O. Weather Delay Report for all calendar months completed, up to the date of substantial completion, and not previously submitted.

P. Progress Schedule, updated and current, indicating progress through the period covered by application and scheduled progress through completion of Work. This is not required with the request for final payment.

Q. Shop Drawing Log for entire project through the period covered by application. If there has been no shop drawing log activity since a previous copy was submitted with a previous application, a single page can be substituted saying so and identifying which pay request had the latest up-to-date log. If a log is long and has many of its early pages unchanged since a previous copy was submitted with a previous application, a single page can be substituted for the earlier unchanged pages saying so and identifying which pay request had the latest copy of those pages.

1.04 CERTIFICATION

A. Designer, if in disagreement with the amounts claimed in an application, may either return application to Contractor for revision and resubmittal, or revise application by hand to indicate corrections Designer considers appropriate.

B. Designer, finding an application complete and correct, will certify the application and return one of the sets to Contractor to indicate the action taken.

END OF SECTION
PART 1 - GENERAL

1.01 SCHEDULING AND ATTENDANCE
   A. The Designer, in cooperation with the Owner and the Contractor, will schedule and administer a Pre-Construction Conference, periodic Progress Meetings, and other specially called or required meetings.
   B. Representatives of the Owner and the Designer will attend.
   C. Representatives of the Contractor, subcontractors, and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents. In the case of the Contractor, the representative shall be one who is authorized to sign change orders.

1.02 PRE-CONSTRUCTION CONFERENCE
   A. A Pre-Construction Conference will be scheduled and conducted at the project site prior to the issuance of the Notice to Proceed.
   B. The Pre-Construction Conference shall be attended by the Contractor's:
      1. (Office) Job Manager
      2. (Field) Job Superintendent
      3. Major subcontractors’ representatives
      4. Major suppliers’ representatives
      5. Others, as desired.
   C. The Pre-Construction Conference is intended to be an opportunity for the Contractor to review administrative, procedural, and temporary facilities requirements of the Contract Documents, and to ask questions concerning the Work.

1.03 PROGRESS MEETINGS
   A. Progress Meetings will be scheduled and conducted at the project site, typically twice-monthly, or when deemed advisable by the Designer.
   B. Progress Meetings shall be attended by the Contractor's:
      1. (Office) Job Manager
      2. (Field) Job Superintendent
      3. Subcontractors' representatives, as befits the agenda
      4. Suppliers' representatives, as befits the agenda
      5. Others, as appropriate.
   C. Progress Meetings are intended to include a monthly opportunity for the Contractor to submit applications for payment, signing of change orders by Designer and Contractor, a general review of the progress of the Work, and identifying and mitigating impediments to timely completion.
   D. Progress Meetings will be scheduled and conducted until final completion.

END OF SECTION
PART 1 - GENERAL

1.01 SUBMITTALS LOG

A. If any shop drawings, product data, or sample submittals are required by the Contract Documents, maintain a submittals log to record the status of submittals made to the Designer.

1. Submit three (3) copies with each application for payment.
2. Clearly identify the Project.
3. Record activities with respect to shop drawings, product data, samples, and such other submittals which are required by the Contract Documents.
4. Indicate for each submittal made to date:
   a. Title or name, and type of submittal.
   b. Date submitted to the Designer.
   c. Date returned by the Designer.
   d. General nature of the Designer's response.

1.02 VISITOR LOG

A. Maintain visitor log in the field office (or with the Project Superintendent when no field office is required) to record visits by all persons not a part of the Contractor's forces, materials suppliers, or subcontractors' forces, until substantial completion of the entire Work.

1. Submit a copy with each counterpart of each application for payment, covering the period since the last log(s) submitted.
2. Clearly identify the Project.
3. Use the form of specification Section 01 31 93, and indicate:
   a. Visitor name and affiliation.
   b. Date and time of visit.
   c. Length of time on site.

END OF SECTION
Please print information below if you represent the Owner, institution, Designer or a consultant, a testing agency engaged by the Owner or Designer, a regulatory authority, or yourself as a private individual. Please estimate how long you will be on site, rather than logging out when you leave.

Persons who are employed by the Contractor, a subcontractor, a sub-subcontractor, a supplier, or a testing agency engaged by any of these, are NOT VISITORS, and should not log in on this Log.

<table>
<thead>
<tr>
<th>Name</th>
<th>Representing</th>
<th>Arrival Date &amp; Time</th>
<th>how long on site</th>
<th>phone number while on site</th>
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PART 1 - GENERAL

1.01 INITIAL PROGRESS SCHEDULE

A. Submit within 21 days of award of the Contract, and not later than the date of submission of the first application for payment. Clearly identify the Project on the schedule.

B. Outline the orderly progress of the Work as planned from the Notice to Proceed through Substantial Completion on the contractually required date. Categorize the Work by Phase (if Phases are specified), major work area, and distinct trade or team, and divide into individual activities of one month or less duration each. Provide an identifiable relationship to the schedule of values. Identify projected monthly progress, points of 50% completion, Substantial Completion, and final completion, and other major milestones. If included in the Work, Commissioning activities and Storm Water Pollution protection Plan (SWPPP) activities shall be among those major milestones. If planting or landscaping that is seasonally sensitive is included in the Work, show that portion of Work distinctly during a seasonally appropriate time.

C. A bar chart or critical path method is acceptable, or other method which is approved by the Designer. Since requests and claims for extension of time require demonstrating effect upon the critical path of Work, a critical path method schedule is recommended, and may be required as supporting documentation to prove validity of a requested or claimed time extensions.

1.02 SUBMITTALS SCHEDULE

A. Submit with the initial Progress Schedule. Clearly identify the Project, and format in a manner similar to the initial progress schedule, utilizing the same method, or make a part of the initial Progress Schedule.

B. Identify submittals to be made. Show date for submission and date by which Designer should respond, allowing sufficient time for review.

C. Designer may require revision of schedule if times allotted for review are insufficient.

1.03 UPDATED PROGRESS SCHEDULE

A. Submit a copy attached to each counterpart of applications for payment.

B. Clearly identify the Project. Format in a manner similar to the initial progress schedule, utilizing the same method.

C. Indicate:
   1. Work as initially scheduled.
   2. Actual progress through the period covered by the current application for payment.
   3. Planned progress through Substantial Completion, including extensions of time made by change order or construction change directive.

D. If actual progress falls behind projections, show how the backlog is to be made up so that the Work will be completed on time.

END OF SECTION
SECTION 01 32 16 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's construction schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Special reports.

B. Related Requirements:
   1. Section 013300 "Submital Procedures" for submitting schedules and reports.
   2. Section 014000 "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
E. Event: The starting or ending point of an activity.

F. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.
2. PDF electronic file.
3. Paper copies as requested.

B. Startup construction schedule.

1. Approval of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.
4. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at monthly intervals.

H. Material Location Reports: Submit at monthly intervals.

I. Site Condition Reports: Submit at time of discovery of differing conditions.

J. Special Reports: Submit at time of unusual event.

K. Qualification Data: For scheduling consultant.
1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including phasing, work stages, area separations, interim milestones, and partial Owner occupancy.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate Contractor's construction schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.


4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.

5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.

6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
4. Products Ordered in Advance: Include a separate activity for each product. Delivery dates indicated stipulate the earliest possible delivery date.
5. Owner-Furnished Products: Include a separate activity for each product. Delivery dates indicated stipulate the earliest possible delivery date.
6. Work Restrictions: Show the effect of the following items on the schedule:
   a. Coordination with existing construction.
   b. Uninterruptible services.
   c. Partial occupancy before Substantial Completion.
   d. Use of premises restrictions.
   e. Provisions for future construction.
   f. Seasonal variations.
   g. Environmental control.

7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
   a. Subcontract awards.
   b. Submittals.
   c. Purchases.
   d. Mockups.
   e. Fabrication.
   f. Sample testing.
   g. Deliveries.
   h. Installation.
   i. Tests and inspections.
   j. Adjusting.
   k. Curing.
   l. Building flush-out.
   m. Startup and placement into final use and operation.
D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion, and the following interim milestones:

1. Permanent enclosure and space conditioning.

E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

1. See Section 012976 "Application and Certificates for Payment" for cost reporting and payment procedures.

F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.

G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice to Proceed. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.3 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (see special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
   1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
   2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

B. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule three days before each regularly scheduled progress meeting.
   1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
   2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
   3. As the Work progresses, indicate final completion percentage for each activity.

C. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
   1. Post copies in Project meeting rooms and temporary field offices.
   2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 32 16
SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:
   1. Preconstruction photographs.
   2. Periodic construction photographs.
   3. Final completion construction photographs.

B. Related Requirements:
   1. Section 013300 "Submittall Procedures" for submitting photographic documentation.
   2. Section 017700 "Closeout Procedures" for submitting photographic documentation as project record documents at Project closeout.
   3. Section 024119 "Selective Structure Demolition" for photographic documentation before selective demolition operations commence.
   4. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For photographer.

B. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

C. Digital Photographs: Submit image files within three days of taking photographs.
   1. Digital Camera: Minimum sensor resolution of 8 megapixels.
   2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
   3. Identification: Provide the following information with each image description in file metadata tag:
      a. Name of Project.
      b. Name and contact information for photographer.
      c. Name of Architect and Construction Manager.
      d. Name of Contractor.
      e. Date photograph was taken.
f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
g. Unique sequential identifier keyed to accompanying key plan.

1.4 USAGE RIGHTS

A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

1. Date and Time: Include date and time in file name for each image.
2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect and Construction Manager.

D. Preconstruction Photographs: Before commencement of excavation commencement of demolition, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect Construction Manager.

1. Flag construction limits before taking construction photographs.
2. Take 40 photographs to show existing conditions adjacent to property before starting the Work.
3. Take 40 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
E. Periodic Construction Photographs: Take 40 photographs monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

F. Architect-Directed Construction Photographs: From time to time, Architect will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.

G. Final Completion Construction Photographs: Take 20 color photographs after date of Substantial Completion for submission as project record documents. Architect will inform photographer of desired vantage points.

H. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Only additional photographs over 200 total photos will be paid for by Change Order and are not included in the Contract Sum.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.
3. Circumstances that could require additional photographs include, but are not limited to, the following:
   a. Immediate follow-up when on-site events result in construction damage or losses.
   b. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to change orders.
   c. Substantial Completion of a major phase or component of the Work.
SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS
   A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
   B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
   C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

1.4 ACTION SUBMITTALS
   A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
      1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
      2. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

3. Format: Arrange the following information in a tabular format:

   a. Scheduled date for first submittal.
   b. Specification Section number and title.
   c. Submittal category: Action; informational.
   d. Name of subcontractor.
   e. Description of the Work covered.
   f. Scheduled date for Architect's final release.
   g. Scheduled date of fabrication.
   h. Scheduled dates for purchasing.
   i. Scheduled dates for installation.
   j. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

   a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

B. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.

   a. Any submittal requiring review by Architect's consultants shall be considered a sequential review.
C. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
   a. File name shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06 10 00.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06 10 00.01.A).
3. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
   a. Project name.
   b. Date.
   c. Name and address of Architect.
   d. Name of Contractor.
   e. Name of firm or entity that prepared submittal.
   f. Names of subcontractor, manufacturer, and supplier.
   g. Category and type of submittal.
   h. Submittal purpose and description.
   i. Specification Section number and title.
   j. Specification paragraph number or drawing designation and generic name for each of multiple items.
   k. Drawing number and detail references, as appropriate.
   l. Location(s) where product is to be installed, as appropriate.
   m. Related physical samples submitted directly.
   n. Indication of full or partial submittal.
   o. Transmittal number, numbered consecutively.
   p. Submittal and transmittal distribution record.
   q. Other necessary identification.
   r. Remarks.

D. Options: Identify options requiring selection by Architect.

E. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

F. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

G. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
H. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals via email as PDF electronic files.
   b. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
   c. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
   a. Manufacturer's catalog cuts.
   b. Manufacturer's product specifications.
   c. Standard color charts.
   d. Statement of compliance with specified referenced standards.
   e. Testing by recognized testing agency.
   f. Application of testing agency labels and seals.
   g. Notation of coordination requirements.
   h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:
   a. Wiring diagrams showing factory-installed wiring.
   b. Printed performance curves.
   c. Operational range diagrams.
   d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:
   a. PDF electronic file.
C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. Identification of products.
   b. Schedules.
   c. Compliance with specified standards.
   d. Notation of coordination requirements.
   e. Notation of dimensions established by field measurement.
   f. Relationship and attachment to adjoining construction clearly indicated.
   g. Seal and signature of professional engineer if specified.

2. Submit Shop Drawings in the following format:
   a. PDF electronic file.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

2. Identification: Attach label on unexposed side of Samples that includes the following:
   a. Generic description of Sample.
   b. Product name and name of manufacturer.
   c. Sample source.
   d. Number and title of applicable Specification Section.
   e. Specification paragraph number and generic name of each item.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.

4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
   a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.

1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.
5. Submit product schedule in the following format:
   a. PDF electronic file.

F. Coordination Drawing Submittals.

G. Contractor's Construction Schedule: Comply with requirements specified in Section 013216 "Construction Progress Documentation."

H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012976 "Payment."

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017770 "Closeout Procedures."

K. Maintenance Data: Comply with requirements specified in Section 017821 "Closeout Submittals."

L. SDG Submittals: Comply with requirements specified in various sections.
M. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

N. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

O. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

P. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

Q. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

R. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

S. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

T. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

U. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

V. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

W. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
X. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

Y. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 01 33 00
SECTION 01 33 43 – ABATEMENT SUBMITTALS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Make Abatement Submittals required by the Contract Documents in a timely manner and at appropriate
times to allow for sufficient review by the Owner's Environmental Consultant. Revise and resubmit as
necessary to establish compliance with the specified requirements.

1.02 WORK INCLUDED

A. Submit complete bound sets of the Abatement Submittals required in the Contract Documents. Submit
separate sets entitled "Pre-Job Submittals" and "Post-Job Submittals".

B. Update Abatement Submittals to Owner's Environmental Consultant on a weekly basis to account for any
new equipment and employees used on the Project.

C. Submit three (3) complete sets of "Pre-Job Submittals" to Owner's Environmental Consultant for review,
at the pre-construction meeting. The abatement Work may not proceed until the complete Pre-Job
Submittal package has been reviewed and accepted by Owner's Environmental Consultant.

D. Submit three (3) complete sets of "Post-Job Submittals" to Owner's Environmental Consultant for review
following the final inspection of abatement Work. Requests for final payment will not be approved until
Post-Job Submittal package has been reviewed and accepted by Owner's Environmental Consultant.

E. Identify individual Abatement Submittals and include table of contents in each package.

1.03 QUALITY ASSURANCE

A. Carefully review and coordinate the various aspects of each item being submitted.

B. Verify that each Abatement Submittal conforms to specified requirements.

C. Certify, by affixing signature of Contractor's authorized representative to the corner of each Abatement
Submittal package, that review, coordination, and verification has taken place.

1.04 PRE-JOB SUBMITTALS

A. Revise and submit progress schedule of abatement Work on a weekly basis.

B. Provide Asbestos Abatement Pre-Job Submittals.
   1. Notice of impending commencement of asbestos removal work in writing (Notice of Demolition
      and/or Asbestos Renovation Form CN-1055) to:

      State of Tennessee Department of Environment and Conservation
      Division of Air Pollution Control
      William Snodgrass – Tennessee Tower
      312 Rosa L. Parks Avenue, 15th Floor
2. Comply with the applicable notice period set forth in EPA 40 CFR 51.146. Include one copy of notification in submittal package along with Certified Mail Receipt of Notification to aforementioned agency. If time from signing of Contract to scheduled start of work is less than applicable notice period, seek waiver of notice period. Do not shorten applicable notice period without written approval.

3. Include all required permits, site location, and arrangements for transport and disposal of asbestos-containing or asbestos-contaminated materials. Identify disposal site proposed for use in disposing of asbestos-containing debris generated in Work. Include owner/operator, address and telephone number. Submit certification that landfill site to be used meets all federal, State, and local regulatory standards.

4. Building permits required by local governmental jurisdiction for the Work.

5. Manufacturer's specifications for air cleaning, vacuum equipment, air handling equipment, special tools, and safety equipment if utilized in Work.

6. Documentation that negative air filtration system meets requirements of Contract Documents, if utilized. Submit copies of manufacturer's specifications including rated flow capacity.

7. Certification naming manufacturer of supplied-air (Type C) respirator equipment if used. Include certification of compliance with Occupational Safety and Health Administration, Environmental Protection Agency, and all other pertinent regulatory agencies. Include rated capacity of each type of equipment used.

8. Manufacturer's certification or independent test reports confirming that materials to be utilized in abatement Work meet or exceed all performance criteria required by Specifications. Include manufacturer's safety data sheets (MSDS) for materials to be used, if available.

9. Written description, sketch, or combination thereof, of plans for construction of a worker and equipment decontamination enclosure system (if required) and for isolation of Work Areas in compliance with Contract Documents.

10. Descriptions of special equipment, techniques, etc., to be used in Work.

11. Asbestos abatement work procedures or practices to be utilized in Work.

12. Listing of asbestos abatement supervisory personnel (including foremen) and their experience, qualifications and training to include:
   a. Supervisor(s) name.
   b. Proof of experience in like projects.
   c. State of Tennessee Certifications to perform and supervise asbestos abatement Work.

13. Listing of workers to be utilized in Work and their experience, qualifications and training to include:
   a. Worker(s) name.
   b. State of Tennessee Certifications to perform asbestos abatement Work.

14. Individually signed and notarized “Certificate of Worker's Release” forms as provided in Subpart 1.05, that each and every asbestos abatement worker to be utilized in Work:
   a. Is actively involved in a company employee respirator protection program and has had appropriate training in respiratory protection.
   b. Is actively involved in an employee medical surveillance program.
   c. Acknowledges proper training and understands their employment in connection with removal and disposal of asbestos-containing materials, the inherent risks of such work, and agreement to assuming these risks.

15. Specimen copy of asbestos abatement worker Sign-In/Sign-Out Log form to be used.

16. Written description and sketch of security plan to be utilized.

17. Health and safety plans for workers/employees conducting the removal, handling, and containerization of asbestos-containing materials, and appropriate personal protective clothing and engineering controls.
C. Other Hazardous Materials Submittals

1. The Contractor shall prepare a written Plan that includes methods for how the Work will be conducted, plans for ensuring the health and safety of workers and visitors, and how workers and visitors will be protected from exposure to hazardous materials and/or conditions. At a minimum, the Plan shall address the following items:
   a. Security procedures to prevent unauthorized entry into controlled areas and workspaces.
   b. Health and safety plans for workers/employees conducting the removal, handling, and containerization of hazardous materials, and appropriate personal protective clothing and engineering controls.
   c. Qualification data for refrigerant recovery technician.
   d. Methods for disconnecting and/or removing PCB-, ODS-, petroleum-, and mercury-containing equipment and other chemical containers in ways that prevent releases of hazardous materials and ensure the health and safety of workers.
   e. Plans for the containerization, labeling, and staging of items and materials after removal, and packaging of hazardous or contaminated materials in a way that minimizes exposure and contamination and facilitates proper off-site handling, transportation, and disposal.
   f. Emergency evacuation for medical or safety reasons such that exposure will be minimized.
   g. Methods for preventing electrical shock hazards.
   h. Methods for identifying and isolating suspect PCB-, ODS-, petroleum-, and mercury-containing equipment, and other chemical containers.
   i. Plans for effective supervision during the work.
   j. Plans for coordinating the off-site disposal and/or recycling of materials.
   k. Immediate notification of Owner and Owner’s Environmental Consultant, clean-up procedures, and decontamination sequence to be used should PCBs, ODSs, mercury, petroleum, or other hazardous compounds be released or encountered uncontained, and an emergency action plan in the event of a spill or contact with eyes or skin. This Plan should be available at the Work site for referral and review by workers/employees, visitors, and the Owner/Owner representatives prior to entry into controlled areas.
   l. Statement of refrigerant recovery: signed by refrigerant recovery technician, stating that all refrigerant present as removed and that recovery was performed according to EPA regulations. Include name and address of technician and date of refrigerant recovery completion.

2. All required permits, site location, and arrangements for transport, recycling, and/or disposal of PCB-containing, mercury-containing, ODS-containing, or petroleum-containing or contaminated materials, and any other hazardous compounds or containers. Submit certification that landfill site or recycling/disposal firm to be used meets all Environmental Protection Agency regulatory standards to accept the disposed materials removed during Work. Include owner/operator, address and telephone number.
1.05  NOTARIZED CERTIFICATE OF ASBESTOS WORKER’S ACKNOWLEDGMENT

PROJECT NAME:  ___________________________________________  DATE:   ___________________________
PROJECT ADDRESS:   ___________________________________________________________________________
ABATEMENT CONTRACTOR’S NAME:   _____________________________________________________________

WORKING WITH ASBESTOS CAN BE DANGEROUS. INHALING ASBESTOS FIBERS HAS BEEN LINKED WITH VARIOUS TYPES OF DISEASES. IF YOU SMOKE AND INHALE ASBESTOS FIBERS, THE CHANCE THAT YOU WILL DEVELOP AN ASBESTOS RELATED DISEASE IS GREATER THAN THAT OF THE NON-SMOKING PUBLIC.

Your employer’s contract with the Owner for the above project requires that you be supplied with the proper respirator and be trained in its use; you will be trained in safe work practices and in the use of the equipment found on the job; and you will receive a medical examination. These requirements are to have been completed at no cost to you. By signing this certificate, you are assuring the Owner that your employer has met these obligations to you.

RESPIRATOR PROTECTION: I have been trained in the proper use of respirators, and informed of the type of respirator to be used on the above-referenced project. I have a copy of the written respiratory protection manual issued by my employer. I have been equipped, at no cost, with the respirator to be used on the above project.

TRAINING COURSE: I have been trained in the dangers inherent in handling asbestos and breathing asbestos fibers in proper work procedures, and personal and area protective measures. The topics covered in the course included the following:
- physical characteristics of asbestos
- health hazards associated with asbestos
- respiratory protection
- negative air systems
- work practices including hands-on or on-job training
- personal decontamination procedures
- air monitoring, personnel and area

MEDICAL EXAMINATION: I have had a medical examination within the past 12 months which was paid for by my employer. This examination included health history, pulmonary function tests, and may have included an evaluation of chest x-ray. I have been notified of the results of my examination.

Signature:    __________________________________________________
Printed Name:    __________________________________________________
Social Security No.   _________________________________________________
Witness:    __________________________________________________
1.06 POST-JOB SUBMITTALS

A. Certificate of Completion.

B. Alphabetical listing of each employee used in Work and exact dates on which they were present in abatement Work Areas.

C. Notarized copy of Sign-In/Sign-Out Log showing the following: date, name, entering and leaving time, company or agency represented and reason for entry for all persons entering Work Areas.

D. Provide Asbestos Abatement Post-Job Submittals:
   1. Asbestos waste log showing date, type of container removed from Work Area, signature of recorder, and time of day.
   2. Map of landfill locating dump areas within landfill wherein asbestos materials were disposed.
   3. Results of any air monitoring testing performed by the abatement Contractor during the Work.

E. Other Hazardous Materials Post-Job Submittals:
   1. Waste log showing date, items removed from Work Area, signature of recorder, and time of day.
   2. Name and address of landfill or recycling/disposal firm accepting other hazardous and non-hazardous materials, and special wastes.
   3. Results of any monitoring or other testing performed by abatement Contractor during the Work.

PART 2 PRODUCTS: NOT USED

PART 3 EXECUTION

3.01 IDENTIFICATION OF SUBMITTALS

A. Contractor shall number consecutively and clearly identify all submittals. Show identification on at least the first page of each submittal, and elsewhere as necessary for positive identification of submittal.

B. Accompany each submittal package with letter of transmittal showing information required for identification and checking.

3.02 TIMING OF SUBMITTALS

A. Make submittals far enough in advance of scheduled dates of commencement, execution, or installation to provide time required for reviews, for securing necessary approvals, for possible revisions and re-submittals, and for placing orders and securing delivery.

B. Accept responsibility for delays resulting from incomplete submittal packages.
3.03 OWNER’S ENVIRONMENTAL CONSULTANT’S REVIEW

A. Partial submittals may be rejected for non-compliance with Contract Documents.

B. Review by Owner’s Environmental Consultant does not relieve abatement Contractor from responsibility for errors which may exist in submitted data.

C. Make revisions when required by Owner’s Environmental Consultant and resubmit for review.

3.04 PAYMENT FOR REVIEW

A. Initial Services: Owner will pay for initial review and first subsequent review, if required.

B. Subsequent Reviews: Costs of Owner’s Environmental Consultant’s additional services associated with reviews required beyond first subsequent review will be responsibility of Contractor, and Owner will deduct corresponding amounts from Contract Sum by appropriate modification.

END OF SECTION 01 33 43
SECTION 01 35 16 - ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes special procedures for alteration work.

1.3 DEFINITIONS

A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.

B. Consolidate: To strengthen loose or deteriorated materials in place.

C. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.

D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.

F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.

G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.

H. Replace: To remove, duplicate, and reinsert entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.

I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.

J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.

K. Retain: To keep existing items that are not to be removed or dismantled.

L. Strip: To remove existing finish down to base material unless otherwise indicated.
1.4 COORDINATION

A. Alteration Work Subschedule: A construction schedule coordinating the sequencing and scheduling of alteration work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration work.

1. Schedule construction operations in sequence required to obtain best Work results.
2. Coordinate sequence of alteration work activities to accommodate the following:
   a. Owner's partial occupancy of completed Work.
   b. Other known work in progress.
   c. Tests and inspections.
3. Detail sequence of alteration work, with start and end dates.
4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.
5. Use of elevator and stairs.
6. Equipment Data: List gross loaded weight, axle-load distribution, and wheel-base dimension data for mobile and heavy equipment proposed for use in existing structure. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.

1.5 PROJECT MEETINGS FOR ALTERATION WORK

A. Preliminary Conference for Alteration Work: Before starting alteration work, Conduct conference at Project site.

1. Attendees: In addition to representatives of Owner, Architect, and Contractor, testing service representative, specialists, and chemical-cleaner manufacturer(s) shall be represented at the meeting.
2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:
   a. Alteration Work Subschedule: Discuss and finalize; verify availability of materials, specialists' personnel, equipment, and facilities needed to make progress and avoid delays.
   b. Fire-prevention plan.
   c. Governing regulations.
   d. Areas where existing construction is to remain and the required protection.
   e. Hauling routes.
   f. Sequence of alteration work operations.
   g. Storage, protection, and accounting for salvaged and specially fabricated items.
   h. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
   i. Qualifications of personnel assigned to alteration work and assigned duties.
   j. Requirements for extent and quality of work, tolerances, and required clearances.
   k. Embedded work such as flashings and lintels, special details, collection of waste, protection of occupants and the public, and condition of other construction that affects the Work or will affect the work.
3. Reporting: Architect will record conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.

B. Coordination Meetings: Conduct coordination meetings specifically for alteration work at monthly intervals. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner, Architect, and Contractor, each specialist, supplier, installer, and other entity concerned with progress or involved in planning, coordination, or performance of alteration work activities shall be represented at these meetings. All participants at conference shall be familiar with Project and authorized to conclude matters relating to alteration work.

2. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of alteration work. Include topics for discussion as appropriate to status of Project.

   a. Alteration Work Subschedule: Review progress since last coordination meeting. Determine whether each schedule item is on time, ahead of schedule, or behind schedule. Determine how construction behind schedule will be expedited with retention of quality; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities are completed within the Contract Time.

   b. Schedule Updating: Revise Contractor's Alteration Work Subschedule after each coordination meeting where revisions to schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.

   c. Review present and future needs of each entity present, including review items listed in the "Preliminary Conference for Alteration Work" Paragraph in this article and the following:

      1) Interface requirements of alteration work with other Project Work.
      2) Status of submittals for alteration work.
      3) Access to alteration work locations.
      4) Effectiveness of fire-prevention plan.
      5) Quality and work standards of alteration work.
      6) Change Orders for alteration work.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.6 MATERIALS OWNERSHIP

A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.

1. Carefully dismantle and salvage each item or object in a manner to prevent damage and protect it from damage, then promptly deliver it to Owner where directed at Project site.
1.7 INFORMATIONAL SUBMITTALS

A. Alteration Work Subschedule:

1. Submit alteration work subschedule within seven days of date established for commencement of alteration work.

B. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor’s alteration work operations.

C. Alteration Work Program: Submit 30 days before work begins.

D. Fire-Prevention Plan: Submit 30 days before work begins.

1.8 QUALITY ASSURANCE

A. Specialist Qualifications: An experienced firm regularly engaged in specialty work similar in nature, materials, design, and extent to alteration work as specified in each Section and that has completed a minimum of five recent projects with a record of successful in-service performance that demonstrates the firm’s qualifications to perform this work.

1. Field Supervisor Qualifications: Full-time supervisors experienced in specialty work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on-site when specialty work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond the control of the specialist firm.

B. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40 CFR 745, Subpart E, and use only workers that are trained in lead-safe work practices.

C. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work Sections.

1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.

2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.

D. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner’s fire-protection equipment and requirements. Include fire-watch personnel’s training, duties, and authority to enforce fire safety.
1.9 STORAGE AND HANDLING OF SALVAGED MATERIALS

A. Salvaged Materials:

1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

B. Salvaged Materials for Reinstallation:

1. Repair and clean items for reuse as indicated.
2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.

C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.

D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.

1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
2. Secure stored materials to protect from theft.
3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F or more above the dew point.

E. Storage Space:

1. Arrange for off-site locations for storage and protection of salvaged material that cannot be stored and protected on-site.

1.10 FIELD CONDITIONS

A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of measured drawings and preconstruction photographs.

1. Comply with requirements specified in Section 013233 "Photographic Documentation."

B. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.
C. Owner's Removals: Before beginning alteration work, verify in correspondence with Owner that the following items have been removed:

D. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.

1. Use only proven protection methods, appropriate to each area and surface being protected.
2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
3. Erect temporary barriers to form and maintain fire-egress routes.
4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
5. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.

B. Temporary Protection of Materials to Remain:

1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.

C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.

D. Utility and Communications Services:

1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.
E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.

1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.

2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

F. Existing Roofing: Prior to the start of work in an area, install roofing protection as indicated on Drawings.

3.2 PROTECTION FROM FIRE

A. General: Follow fire-prevention plan and the following:

1. Comply with NFPA 241 requirements unless otherwise indicated.

2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.

   a. If combustible material cannot be removed, provide fire blankets to cover such materials.

B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:

   1. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.

   2. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.

   3. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.

   4. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.

C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.

D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.

   1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.
3.3 PROTECTION DURING APPLICATION OF CHEMICALS

A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.

B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.

C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.

D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.

E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL ALTERATION WORK

A. Have specialty work performed only by qualified specialists.

B. Ensure that supervisory personnel are present when work begins and during its progress.

C. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation photographs Comply with requirements in Section 013233 "Photographic Documentation."

D. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.

E. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.

1. Do not proceed with the work in question until directed by Architect.

END OF SECTION 01 35 16
SECTION 01 35 91 - HISTORIC TREATMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section includes general protection and treatment procedures for designated historic spaces, areas, rooms, and surfaces in Project.

1.3 DEFINITIONS
   A. Consolidate: To strengthen loose or deteriorated materials in place.
   B. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.
   C. Dismantle: To disassemble or detach a historic item from a surface, or a nonhistoric item from a historic surface, using gentle methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
   D. Historic: Spaces, areas, rooms, surfaces, materials, finishes, and overall appearance that are important to the successful rehabilitation restoration and reconstruction as determined by Architect. Designated historic areas rooms and surfaces include all existing areas designated to remain, be reused or restored in the drawings.
     1. Exterior Facades and Slate Roof w/ Dormers: Areas of greatest architectural importance, integrity, and visibility; to be preserved and restored to the original, circa, design and finish as indicated on Drawings.
     2. Interior areas designated for repair, restoration and/or reuse: Areas of significant architectural importance, integrity, and visibility; to be preserved and restored consistent with the remaining historic fabric and to the extent indicated on Drawings.
     3. Interior areas with minimal work indicated, such as basement mechanical room: Areas of slight architectural importance, integrity, and visibility; to leave any remaining original fabric untouched insofar as is consistent with accommodating modern uses for the building as indicated on Drawings.
   E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.
   F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.
G. Reinstall: To protect removed or dismantled item, repair and clean it as indicated for reuse, and reinstall it in original position, or where indicated.

H. Remove: To take down or detach a nonhistoric item located within a historic space, area, or room, using methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

I. Repair: To correct damage and defects, retaining existing materials, features, and finishes while employing as little new material as possible. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.

J. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.

K. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.

L. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.

M. Restore: To consolidate, replicate, reproduce, repair, and refinish as required to achieve the indicated results.

N. Retain: To keep existing items that are not to be removed or dismantled.

O. Reversible: New construction work, treatments, or processes that can be removed or undone in the future without damaging historic materials unless otherwise indicated.

P. Salvage: To protect removed or dismantled items and deliver them to Owner [ready for reuse].

Q. Stabilize: To provide structural reinforcement of unsafe or deteriorated items while maintaining the essential form as it exists at present; also, to reestablish a weather-resistant enclosure.

R. Strip: To remove existing finish down to base material unless otherwise indicated.

1.4 COORDINATION

1.5 PROJECT MEETINGS FOR HISTORIC TREATMENT

A. Preliminary Historic Treatment Conference: Before starting historic treatment work, conduct conference at Project site.

1. Attendees: In addition to representatives of Owner, Construction Manager, Architect, and Contractor, testing service representative, historic treatment specialists, chemical-cleaner manufacturer, and installers whose work interfaces with or affects historic treatment shall be represented at the meeting.

2. Agenda: Discuss items of significance that could affect progress of historic treatment work, including review of the following:
a. Historic Treatment Subschedule: Discuss and finalize; verify availability of materials, historic treatment specialists’ personnel, equipment, and facilities needed to make progress and avoid delays.
b. Fire-prevention plan.
c. Governing regulations.
d. Areas where existing construction is to remain and the required protection.
e. Hauling routes.
f. Sequence of historic treatment work operations.
g. Storage, protection, and accounting for salvaged and specially fabricated items.
h. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
i. Qualifications of personnel assigned to historic treatment work and assigned duties.
j. Requirements for extent and quality of work, tolerances, and required clearances.
k. Methods and procedures related to historic treatments, including product manufacturers' written instructions and precautions regarding historic treatment procedures and their effects on materials, components, and vegetation.
l. Embedded work such as flashings and lintels, special details, collection of wastes, protection of occupants and the public, and condition of other construction that affect the Work or will affect the work.

3. Reporting: Construction Manager will record conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.
   1) work.
   2) Change Orders for historic treatment work.

4. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.6 MATERIALS OWNERSHIP

A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.

1. Carefully dismantle and salvage each item or object and protect it from damage, then promptly deliver it to Owner where directed.

1.7 INFORMATIONAL SUBMITTALS

A. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by Contractor’s historic treatment operations.

B. Fire-Prevention Plan: Submit 10 days before work begins.
1.8 QUALITY ASSURANCE

1. Field Supervisor Qualifications: Full-time supervisors experienced in historic treatment work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on Project site when historic treatment work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond the control of the specialist firm.

   a. Construct new mockups of required work whenever a supervisor is replaced.

B. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-prevention devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.


1.9 STORAGE AND HANDLING OF HISTORIC MATERIALS

A. Salvaged Historic Materials:

1. Clean loose dirt and debris from salvaged historic items unless more extensive cleaning is indicated.
2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

B. Historic Materials for Reinstallation:

1. Repair and clean historic items for reuse as indicated.
2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make item functional for use indicated.

C. Existing Historic Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after historic treatment and construction work in the vicinity is complete.

D. Storage: Catalog and store historic items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.

1. Identify each item with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
2. Secure stored materials to protect from theft.
3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F (3 deg C) or more above the dew point.

E. Storage Space:
1. Arrange for off-site locations for storage and protection of historic material that cannot be stored and protected on-site.

1.10 FIELD CONDITIONS
A. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.

B. Size Limitations in Historic Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches (300 mm) or more.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION, GENERAL
A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from historic treatment procedures.

1. Use only proven protection methods, appropriate to each area and surface being protected.
2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where historic treatment work is being performed.
3. Erect temporary barriers to form and maintain fire-egress routes.
4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during historic treatment work.
5. Contain dust and debris generated by historic treatment work, and prevent it from reaching the public or adjacent surfaces.
6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.

B. Temporary Protection of Historic Materials:

1. Protect existing historic materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
2. Do not attach temporary protection to historic surfaces except as indicated as part of the historic treatment program and approved by Architect.

C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.

D. Utility and Communications Services:
1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by historic treatment work before commencing operations.
2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for historic treatment work.
3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.

E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.
1. Prevent solids such as stone or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from historic treatment work.
2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

F. Existing Roofing: Prior to the start of work in an area, install roofing protection as required to maintain Owner’s current roofing warranties

3.2 PROTECTION FROM FIRE

A. General: Follow fire-prevention plan and the following:
2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
   a. If combustible material cannot be removed, provide fire blankets to cover such materials.
3. Prohibit smoking by all persons within Project work and staging areas.

B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:
1. Obtain Owner's approval for operations involving use of welding or other high-heat equipment. Use of open-flame equipment is not permitted. Notify Owner at least 72 hours before each occurrence, indicating location of such work.
2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:

   a. Train each fire watch in the proper operation of fire-control equipment and alarms.
   b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
   c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
   d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work at each area of Project site to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
   e. Maintain fire-watch personnel at each area of Project site until 60 minutes after conclusion of daily work.

C. Fire Extinguishers, Fire Blankets, and Rag Buckets: Maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.

D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.

1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is completed.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

A. Protect motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm or damage resulting from applications of chemicals and adhesives.

B. Cover adjacent surfaces with protective materials that are proved to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in historic treatment program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer’s written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.

C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.

D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.

E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.
3.4 GENERAL HISTORIC TREATMENT

A. Have historic treatment work performed only by qualified historic treatment specialists.

B. Ensure that supervisory personnel are present when historic treatment work begins and during its progress.

C. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation photographs or video recordings. Comply with requirements in Section 013233 "Photographic Documentation."

D. Perform surveys of Project Site as the Work progresses to detect hazards resulting from historic treatment procedures.

E. Follow the procedures in subparagraphs below and procedures approved in historic treatment program unless otherwise indicated:

1. Retain as much existing material as possible; repair and consolidate rather than replace.
2. Use additional material or structure to reinforce, strengthen, prop, tie, and support existing material or structure.
3. Use reversible processes wherever possible.
4. Use historically accurate repair and replacement materials and techniques unless otherwise indicated.
5. Record existing work before each procedure (preconstruction) and progress during the work with digital preconstruction documentation photographs or video recordings. Comply with requirements in Section 013233 "Photographic Documentation."

F. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.

1. Do not proceed with the work in question until directed by Architect.

G. Where missing features are indicated to be repaired or replaced, provide work with appearance based on accurate duplications rather than on conjecture, subject to approval of Architect.

H. Where work requires existing features to be removed or dismantled and reinstalled, perform these operations without damage to the material itself, to adjacent materials, or to the substrate.

I. Identify new and replacement materials and features with permanent marks hidden in the completed Work to distinguish them from original materials. Record a legend of identification marks and the locations of the items on record Drawings.

END OF SECTION 013591
SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.

3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

A. Shop Drawings: For mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.

1. Indicate manufacturer and model number of individual components.
2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.9 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to [ASTM E 329]; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:
   a. Provide test specimens representative of proposed products and construction.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
   d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
   e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
   a. Allow seven days for initial review and each re-review of each mockup.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed unless otherwise indicated.

1.10 QUALITY CONTROL

A. Contractor Responsibilities: Tests and inspections are the Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Contractor shall engage a qualified testing agency to perform these quality-control services.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.

4. Submit a certified written report, in duplicate, of each quality-control service.

5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.

6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

C. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.


   1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
   2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
   3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
   4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
   5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
   6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

   1. Access to the Work.
   2. Incidental labor and facilities necessary to facilitate tests and inspections.
   3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
   4. Facilities for storage and field curing of test samples.
   5. Delivery of samples to testing agencies.
   6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
   7. Security and protection for samples and for testing and inspecting equipment at Project site.
G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend
restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00
### PART 1 - GENERAL

#### 1.01 CODES AND REGULATIONS

**A.** The Regulatory Requirements used for Tennessee Board of Regents projects are listed below as a convenience and may not be inclusive of all that apply. Others may also apply. Comply with all pertinent codes, standards, regulations and laws.

<table>
<thead>
<tr>
<th></th>
<th>Document</th>
<th>Source</th>
<th>Phone</th>
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<tr>
<td>3</td>
<td>2007 Tennessee Elevator Safety Board Rules Chapter 0800-3-4 Elevators, Dumbwaiters, Escalators, and other Lifts 2007 Board of Boiler Rules Chapter 0800-3-3 Boiler Inspections</td>
<td>Tn. Dept. of Labor and Workforce Development Div. of Boiler, Elevator &amp; Amusement Device Inspection 220 French Landing Drive Nashville, TN 37243-1006</td>
<td>(615) 741-2123</td>
</tr>
<tr>
<td>5</td>
<td>Tennessee Chapters 0780-2-1, Electrical Installations 0780-2-2, Codes &amp; Standards 0780-2-3, Plan &amp; Spec Review 0780-2-18, Equitable Restrooms</td>
<td>Department of Commerce and Insurance Fire Prevention Division Codes Enforcement Section 500 James Robertson Parkway Nashville, Tennessee 37243-1162</td>
<td>(615) 741-2981</td>
</tr>
<tr>
<td>6</td>
<td>ADA Title II, State and local government facilities must follow the requirements of the 2010 standards, including both the Title II regulations at 28 CFR 35.151 and the 2004 ADAAG at 36 CFR part 1191, appendices B and D. In the few places where requirements between the two differ, the requirements of 28 CFR 35.151 prevail. The compliance date is March 15, 2012, for all newly constructed or altered State and local government facilities permitted after this date. ADA Title III, Public accommodations and commercial facilities must follow the requirements of the 2010 standards, including both the Title III regulations at 28 CFR part 36, subpart D: and the 2004 ADAAG at 36 CFR part1191, appendices B and D. In the few places where requirements between the two differ, the requirements of 28 CFR part 36, subpart D prevail. The compliance date is March 15, 2012, for all newly constructed or altered facilities permitted after this date.</td>
<td>U.S. Department of Justice Civil Rights Division, Disability Rights Section-NYA 950 Pennsylvania Ave, NW Washington, DC 20530</td>
<td>(202) 514-4609</td>
</tr>
<tr>
<td>7</td>
<td>TDEC Division of Water Pollution Control Tennessee water quality control act of 1977 (TCA 69-3-101)</td>
<td>Tennessee Department of Environment and Conservation Division of Water Pollution Control 401 Church Street Nashville, TN 37243</td>
<td>(615) 532-0625</td>
</tr>
</tbody>
</table>
SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale’s "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com
2. AAMA - American Architectural Manufacturers Association; www.aamanet.org
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org
7. ABMA - American Boiler Manufacturers Association; www.abma.com
8. ACI - American Concrete Institute; (Formerly: ACI International); www.abma.com
9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org
11. AF&PA - American Forest & Paper Association; www.afandpa.org
12. AGA - American Gas Association; www.gaa.org
13. AHAM - Association of Home Appliance Manufacturers; www.aham.org
15. AI - Asphalt Institute; www.asphaltinstitute.org
16. AIA - American Institute of Architects (The); www.aia.org
17. AISC - American Institute of Steel Construction; www.aisc.org
18. AISI - American Iron and Steel Institute; www.steel.org
19. AITC - American Institute of Timber Construction; www.aiwakeglulam.org
23. APA - APA - The Engineered Wood Association; www.apawood.org
24. APA - Architectural Precast Association; www.archprecast.org
25. API - American Petroleum Institute; www.api.org
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org
29. ASCE - American Society of Civil Engineers; www.asce.org
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; [www.ashrae.org]
32. ASME - American Society of Mechanical Engineers; [www.asme.org]
33. ASSE - American Society of Safety Engineers; [www.asse.org]
34. ASSE - American Society of Sanitary Engineering; [www.asse-plumbing.org]
35. ASTM - American Society for Testing and Materials; [www.astm.org]
36. ATIS - Alliance for Telecommunications Industry Solutions; [www.atis.org]
37. AWEA - American Wind Energy Association; [www.awea.org]
38. AWI - Architectural Woodwork Institute; [www.awinet.org]
40. AWPA - American Wood Protection Association; [www.awpa.com]
41. AWS - American Welding Society; [www.aws.org]
42. AWWA - American Water Works Association; [www.awwa.org]
43. BHMA - Builders Hardware Manufacturers Association; [www.buildershardware.com]
44. BIA - Brick Industry Association; [www.gobrick.com]
45. BICSI - BICSI, Inc.; [www.bicsi.org]
46. BIFMA - Business and Institutional Furniture Manufacturer's Association; [www.bifma.org]
47. BISSC - Baking Industry Sanitation Standards Committee; [www.bissc.org]
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); [www.bissc.org]
49. CDA - Copper Development Association; [www.copper.org]
50. CEA - Canadian Electricity Association; [www.csea.org]
51. CEA - Consumer Electronics Association; [www.csea.org]
52. CFFA - Chemical Fabrics and Film Association, Inc.; [www.chemicalfabricsandfilm.com]
53. CFSEI - Cold-Formed Steel Engineers Institute; [www.cfsei.org]
54. CGA - Compressed Gas Association; [www.cganet.com]
55. CIMA - Cellulose Insulation Manufacturers Association; [www.cellulose.org]
56. CISCA - Ceilings & Interior Systems Construction Association; [www.cisca.org]
57. CISPI - Cast Iron Soil Pipe Institute; [www.cispi.org]
58. CLFMI - Chain Link Fence Manufacturers Institute; [www.chainlinkinfo.org]
59. CPA - Composite Panel Association; [www.pbmdf.com]
60. CRI - Carpet and Rug Institute; [www.carpet-rug.org]
61. CRRC - Cool Roof Rating Council; [www.coolroofs.org]
62. CRSI - Concrete Reinforcing Steel Institute; [www.crsi.org]
63. CSA - Canadian Standards Association; [www.csa.ca]
64. CSA - CSA International; (Formerly: IAS - International Approval Services); [www.csa-international.org]
65. CSI - Construction Specifications Institute; (Formerly: CSIA - Construction Specifications Institute); [www.csinet.org]
66. CSSB - Cedar Shake & Shingle Bureau; [www.cedarbureau.org]
67. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); [www.cti.org]
68. CWC - Composite Wood Council; (See CPA)
69. DASMA - Door and Access Systems Manufacturers Association; [www.dasma.com]
70. DHI - Door and Hardware Institute; [www.dhi.org]
71. ECA - Electronic Components Association; (See ECIA).
72. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
73. ECIA - Electronic Components Industry Association; [www.eciaonline.org]
74. EIA - Electronic Industries Alliance; (See TIA).
75. EIMA - EIFS Industry Members Association; [www.eima.com]
76. EJMA - Expansion Joint Manufacturers Association, Inc.; [www.ejma.org]
77. ESD - ESD Association; (Electrostatic Discharge Association); [www.esda.org]
78. ESTA - Entertainment Services and Technology Association; (See PLASA).
80. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
81. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
82. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
84. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
90. GS - Green Seal; www.greenseal.org.
92. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
93. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
97. IAS - International Accreditation Service; www.iasonline.org.
98. IAS - International Approval Services; (See CSA).
99. ICBO - International Conference of Building Officials; (See ICC).
101. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
102. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
103. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
105. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
106. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
107. IESNA - Illuminating Engineering Society of North America; (See IES).
108. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
111. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
112. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
113. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
114. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
115. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
117. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
118. ITU - International Telecommunication Union; www.itu.int/home.
120. LMA - Laminating Materials Association; (See CPA).
REFERENCES

123. MCA - Metal Construction Association; www.metalconstruction.org.
132. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
137. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
140. NECA - National Electrical Contractors Association; www.necanet.org.
143. NETA - InterNational Electrical Testing Association; www.netaworld.org.
144. NFHS - National Federation of State High School Associations; www.nfhs.org.
146. NFPA - NFPA International; (See NFPA).
149. NLGA - National Lumber Grades Authority; www.nlga.org.
150. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
152. NRCA - National Roofing Contractors Association; www.nrca.net.
156. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
159. PCI - Precast/Prestressed Concrete Institute; wwwpci.org.
161. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
166. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
168. SDI - Steel Door Institute; www.steeldoor.org.
169. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
170. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
172. SJI - Steel Joist Institute; www.steeljoist.org.
175. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
176. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
185. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
188. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
189. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
196. USAV - USA Volleyball; www.usavolleyball.org.
200. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
201. WCPA - Window & Door Manufacturers Association; www.wcpa.org.
204. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
205. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
5. DOE - Department of Energy; [www.energy.gov](http://www.energy.gov).
6. EPA - Environmental Protection Agency; [www.epa.gov](http://www.epa.gov).
13. SD - Department of State; [www.state.gov](http://www.state.gov).
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; [www.ars.usda.gov](http://www.ars.usda.gov).
17. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; [www.quicksearch.dla.mil](http://www.quicksearch.dla.mil).
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; [www.access-board.gov](http://www.access-board.gov).
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; [www.bearhfti.ca.gov](http://www.bearhfti.ca.gov).
2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
3. CDHS; California Department of Health Services; (See CDPH).
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservice.tamu.edu.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200
PART 1 - GENERAL

1.01 CONTRACTOR'S RESPONSIBILITIES

A. Employ and pay for the services of an independent testing laboratory, approved by the Designer, to perform specified services and testing. Employment of laboratory does not relieve Contractor's obligations to perform the Work of the Contract.

B. Coordinate and pay for inspections and testing required by law, ordinance, rules, regulations, orders, or approvals of public authorities as required by the Contract Documents.
   1. Furnish copies of Products Test reports as required.
   2. Furnish incidental labor and facilities to facilitate inspections and tests and for storage and curing of test samples.
   3. Notify the lab sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.
   4. Make arrangements with lab and pay for additional samples and tests required for Contractor's convenience.

1.02 TESTING LABORATORY

A. Qualifications:
   1. Meet "Recommended Requirements for Independent Laboratory Qualification", published by the American Council of Independent Laboratories, and Basic requirements of ASTM E 329 "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction".
   2. Be authorized to operate in the State of Tennessee.
   3. Submit copies to the Designer of the report of inspection of facilities made by Materials Reference Laboratory of National Bureau of Standards during the most recent tour of inspection with the memorandum of remedies of any deficiencies reported by the inspection.

B. Duties and limitations of authority:
   1. Perform specified inspections, sampling, and testing of materials and methods of construction and promptly submit five copies of the written report of each test and inspection to the Designer.
   2. Laboratory is not authorized to release, revoke, alter or enlarge on requirements of the Contract Documents, approve or accept portions of the Work, or perform duties of the Contractor.

END OF SECTION
SECTION 01 43 28 - TESTING AND LABORATORY SERVICES FOR HAZARDOUS MATERIALS ABATEMENT

PART 1 – GENERAL

1.01 DESCRIPTION

A. The Owner will provide a Tennessee-licensed Project Monitor and qualified Testing Laboratory to perform final clearance testing of indoor asbestos abatement Work performed under Contract Documents to determine general compliance, unless building components with encapsulated ACMs are removed intact.

B. Owner’s representative and Testing Laboratory will perform final clearance testing necessary to determine general compliance with Contract Documents, and observe and document on a regular basis the execution and progress of the Work. Such observation and documentation shall be for the sole benefit of the Owner and shall not be construed in any way as to include responsibility for abatement contractor’s means, methods, techniques, sequences, or procedures involved with execution of the Work, nor shall such observation and documentation by Project Monitor and Testing Laboratory be construed to include responsibility for any safety programs or procedures either utilized or not utilized by abatement contractor during work.

C. Provision of Asbestos Project Monitor and Testing Laboratory by Owner to perform testing for Owner shall not relieve abatement contractor from providing its own testing for compliance with specifications and/or OSHA regulations.

1.02 WORK INCLUDED

A. Cooperate with Owner’s monitoring representative and Testing Laboratory in all aspects of testing to expedite testing and results.

B. Provide the Owner’s representative access to Work at all times and in all locations requested as necessary to perform testing.

C. Pay for testing subsequent to noncompliance of preliminary or final air tests as required in Contract Documents.

1.03 WORK NOT INCLUDED

A. Selection of monitoring representative or Testing Laboratory.

B. Payment for initial compliance testing and initial laboratory services.

1.04 QUALITY ASSURANCE

A. Any environmental air testing for asbestos abatement Work shall be performed in general accordance with procedures outlined in the National Institute for Occupational Safety and Health (NIOSH) Method 7400 with analysis by Phase Contrast Microscopy (PCM), and also will follow guidelines issued by Environmental Protection Agency regarding detection limits.
B. Final clearance inspections and air testing for asbestos abatement Work will be performed in general
accordance with EPA "Silver Book" – Measuring Airborne Asbestos Following an Abatement Action (EPA
600/4-85-049, November, 1985).

1.05 PAYMENT FOR TESTING

A. Initial Services. The Owner will pay for regulatory specified events of project monitoring and final
clearance testing required by Contract Documents.

B. Retesting. When final clearance tests indicate noncompliance with Contract Documents, subsequent
retesting will be performed by same monitoring representative and Testing Laboratory, and associated
costs will be responsibility of abatement contractor. These costs will be deducted by Owner from Contract
Sum by appropriate Modification.

C. Additional Testing. When additional testing is required due to abatement contractor noncompliance with
Contract Documents, subsequent and additional testing shall be performed by Owner’s monitoring
representative and Testing Laboratory, and associated costs will be responsibility of abatement
contractor. These costs will be deducted by Owner from Contract Sum by appropriate Modification.

1.06 SCHEDULING

A. Owner’s monitoring representative and Testing Laboratory may perform tests in Areas and at times during
the Work as deemed necessary by the monitoring representative and as specified in the Contract
Documents.

B. Notify Owner’s monitoring representative of need for preliminary and final testing at least 24 hours prior to
desired time of testing.

C. Coordinate other scheduling with Owner, Owner’s Environmental Consultant, and monitoring
representative as necessary.

1.07 RESULTS

A. Owner’s monitoring representative and Testing Laboratory will perform all testing analysis promptly and
issue results expeditiously in order to minimize any possible delay in the progress of the Work.

B. Test results shall be available to Owner, Owner’s Environmental Consultant, and abatement contractor as
follows:

1. Clearance results: 24 hours following tests.
2. Results of other tests deemed necessary by Owner’s Environmental Consultant; as quickly as
possible, but not earlier than 24 hours following completion of tests.

C. Tests may be made both inside and outside or Work Areas. Abatement contractor is cautioned that
should interpretations be made, opinions be formed, and conclusions be drawn as a result of examining
the test results, that these interpretations, opinions and conclusions will be those made, formed and
drawn solely by abatement contractor. Abatement contractor is responsible for performing personnel air
tests required for its evaluation of the safety of its employees.

END OF SECTION 01 43 28
SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.
2. Section 312319 "Dewatering" for disposal of ground water at Project site.

1.3 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.

B. Water from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

C. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.

3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

D. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
5. Other dust-control measures.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide concrete or galvanized-steel bases for supporting posts.

B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot-square tack and marker boards.
3. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
4. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures”.

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

2. Contact Owner's Representatives before any utility shutdown or interruption:
   a. Eddie Harkleroad  
      Office (423) 439-7749
   b. Ian Watson  
      Office (423) 439-7762  
      Mobile (423) 202-2642

3. Give 2 working days advance notice of any utility shutdown or interruption that will affect occupied building spaces.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

F. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

G. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied adjacent buildings on campus.

H. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
I. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
   1. Connect temporary service to Owner's existing power source, as directed by Owner.

J. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
   1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
   2. Provide superintendent with cellular telephone for use.

K. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
   1. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
   1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
   2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 312000 "Earth Moving."
   3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
   4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course.

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
   1. Protect existing site improvements to remain including curbs, pavement, and utilities.
   2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
   1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
   1. Identification Signs: Provide Project identification signs as indicated on Drawings.
   2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
      a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touchup signs so they are legible at all times.

G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
   1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

I. Temporary Elevator Use: Use of new elevator is not permitted.

J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

K. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
   1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

L. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Temporary Erosion and Sedimentation Control: Comply with requirements specified in Section 311000 "Site Clearing."
D. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

E. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

F. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

G. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

H. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.

I. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

J. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

K. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.5 MOISTURE AND MOLD CONTROL


B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard, replace, or clean stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use permanent HVAC system to control humidity.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

   a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
   b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
   c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.
3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Decorum: All personnel onsite to maintain appropriate and professional decorum. Construction activities will occur in student, faculty and staff occupied facility and appropriate behavior and non-solicitation shall be in place at all times.

C. Maintenance: Maintain facilities in good operating condition until removal.
   1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

E. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
   1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
   2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
   3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 “Closeout Procedures.”

END OF SECTION 01 50 00
PART 1 - GENERAL

1.01 ENVIRONMENTAL HAZARDOUS PRODUCTS, MATERIALS, OR WASTES

A. Do not incorporate in the Work hazardous materials or products as currently defined in the Resource Conservation and Recovery Act of 1976 (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), or Environmental Protection Agency (EPA) regulations, rules, or requirements, as amended, unless the Contract Documents give no other option than to provide a material or product which contains a hazardous material, component, constituent, waste, or leachate. In studying the Contract Documents and carrying out the Work, report at once to the Designer the discovery of a product or material which contains hazardous materials, components, constituents, waste, or leachate.

B. Do not incorporate in the Work a product or material which contains concentrations of a constituent, component, or material above the threshold levels which would require adherence to hazardous waste disposal regulations as currently defined, or could cause a release or threat of release of a hazardous substance at a level that would require a remedial response or removal action as currently defined by RCRA, CERCLA, or the EPA.

C. Select materials and products meeting specified requirements which comply with EPA requirements as regards hazardous materials content. In making requests for substitutions, determine that materials and products proposed for substitution comply with RCRA, CERCLA, and EPA requirements.

END OF SECTION
SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

B. Related Requirements:
   1. Section 013300 "Submittal Procedures" for submitting surveys.
   2. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
   3. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
   4. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
1. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
   
a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

D. Final Property Survey: Submit 2 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements not specifically shown on the Contract Documents, notify Architect and Engineer of locations and details of cutting and await directions from Architect and Engineer before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

a. Primary operational systems and equipment.
b. Fire separation assemblies.
c. Air or smoke barriers.
d. Fire-suppression systems.
e. Mechanical systems piping and ducts.
f. Control systems.
g. Communication systems.
h. Fire-detection and -alarm systems.
i. Electrical wiring systems.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

a. Water, moisture, or vapor barriers.
b. Membranes and flashings.
c. Sprayed fire-resistive material.
d. Equipment supports.
e. Piping, ductwork, vessels, and equipment.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.

2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for
compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
   1. Description of the Work.
   2. List of detrimental conditions, including substrates.
   3. List of unacceptable installation tolerances.
   4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.

2. Establish limits on use of Project site.

3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

4. Inform installers of lines and levels to which they must comply.

5. Check the location, level and plumb, of every major element as the Work progresses.

6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.

7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

D. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied adjacent buildings.

F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.

3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.

5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

6. Proceed with patching after construction operations requiring cutting are complete.

G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into
retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
   b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another,
   patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform
   finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with
   new materials, if necessary, to achieve uniform color and appearance.
   a. Where patching occurs in a painted surface, prepare substrate and apply primer and
      intermediate paint coats appropriate for substrate over the patch, and apply final paint coat
      over entire unbroken surface containing the patch. Provide additional coats until patch
      blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface
   of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a
   weathertight condition and ensures thermal and moisture integrity of building enclosure.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils,
   putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's
   construction personnel.
   1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's
      portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify
      Owner if changes to schedule are required due to differences in actual construction progress.
   2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences
      covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences
      conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly.
   Dispose of materials lawfully.
   2. Do not hold waste materials more than seven days during normal weather or three days if the
      temperature is expected to rise above 80 deg F.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark
      containers appropriately and dispose of legally, according to regulations.
a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 91 13 "Commissioning."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00
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<th>EST. QUANTITY OF MATERIALS RECEIVED* (A)</th>
<th>EST. WASTE - % (B)</th>
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**FORM CWM-5: COST/REVENUE ANALYSIS OF CONSTRUCTION WASTE REDUCTION WORK PLAN**

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## FORM CWM-7: CONSTRUCTION WASTE REDUCTION PROGRESS REPORT

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## FORM CWM-8: DEMOLITION WASTE REDUCTION PROGRESS REPORT

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SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:
   1. Salvaging nonhazardous demolition and construction waste.
   2. Recycling nonhazardous demolition and construction waste
   3. Disposing of nonhazardous demolition and construction waste

B. Related Requirements:
   1. Section 024119 "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.
   2. Section 042000 "Unit Masonry" for disposal requirements for masonry waste.
   3. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the
course of the Work. Use all reasonable means to divert construction and demolition waste from landfills
and incinerators. Facilitate recycling and salvage of materials including the following:

1. Demolition Waste:
   
   a. Asphalt paving.
   b. Concrete.
   c. Concrete reinforcing steel.
   d. Brick.
   e. Concrete masonry units.
   f. Wood studs.
   g. Wood joists.
   h. Plywood and oriented strand board.
   i. Wood paneling.
   j. Wood trim.
   k. Structural and miscellaneous steel.
   l. Rough hardware.
   m. Roofing.
   n. Insulation.
   o. Doors and frames.
   p. Door hardware.
   q. Windows.
   r. Glazing.
   s. Metal studs.
   t. Gypsum board.
   u. Acoustical tile and panels.
   v. Carpet.
   w. Carpet pad.
   x. Demountable partitions.
   y. Equipment.
   z. Cabinets.
   aa. Plumbing fixtures.
   bb. Piping.
   cc. Supports and hangers.
   dd. Valves.
   ee. Sprinklers.
   ff. Mechanical equipment.
   gg. Refrigerants.
   hh. Electrical conduit.
   ii. Copper wiring.
   jj. Lighting fixtures.
   kk. Lamps.
   ll. Ballasts.
   mm. Electrical devices.
   nn. Switchgear and panelboards.
   oo. Transformers.

2. Construction Waste:

   a. Masonry and CMU.
   b. Lumber.
c. Wood sheet materials.
d. Wood trim.
e. Metals.
f. Roofing.
g. Insulation.
h. Carpet and pad.
i. Gypsum board.
j. Piping.
k. Electrical conduit.
l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
   1) Paper.
   2) Cardboard.
   3) Boxes.
   4) Plastic sheet and film.
   5) Polystyrene packaging.
   7) Plastic pails.

1.5 ACTION SUBMITTALS
A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.

1.6 INFORMATIONAL SUBMITTALS
A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste. Include the following information:
   1. Material category.
   2. Generation point of waste.
   3. Total quantity of waste in tons.
   4. Quantity of waste salvaged, both estimated and actual in tons.
   5. Quantity of waste recycled, both estimated and actual in tons.
   6. Total quantity of waste recovered (salvaged plus recycled) in tons.
   7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. **STATE SDG Submittal:** Submit documentation to DESIGNER, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met. Respond to questions and requests from DESIGNER regarding construction waste management and disposal until the DESIGNER has made its determination on the Project's STATE SDG certification. Document correspondence with DESIGNER as informational submittals.

H. Qualification Data: For **refrigerant recovery technician.**

I. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

**1.7 QUALITY ASSURANCE**

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 013119 "Project Meetings." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

**1.8 WASTE MANAGEMENT PLAN**

A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include estimated quantities and assumptions for estimates.
C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Use Form CWM-5 for construction waste and Form CWM-6 for demolition waste. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
3. Total cost of disposal (with no waste management).
4. Revenue from salvaged materials.
5. Revenue from recycled materials.
7. Savings in hauling and tipping fees that are avoided.
8. Handling and transportation costs. Include cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
   1. Distribute waste management plan to everyone concerned within three days of submittal return.
   2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
   2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

E. Waste Management in Historic Zones or Areas: Hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by 12 inches or more.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
   3. Store items in a secure area until installation.
   4. Protect items from damage during transport and storage.
   5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area designated by Owner.
   5. Protect items from damage during transport and storage.

D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
F. Plumbing Fixtures: Separate by type and size.

G. Lighting Fixtures: Separate lamps by type and protect from breakage.

H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
   1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
      a. Inspect containers and bins for contamination and remove contaminated materials if found.
   2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
   4. Store components off the ground and protect from the weather.
   5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Grind asphalt to maximum 1-1/2-inch size.

B. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.

C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
   1. Pulverize concrete to maximum 14-inch (100-mm) size.
   2. Crush concrete and screen to comply with requirements in Section 312000 "Earth Moving" for use as satisfactory soil for fill or subbase.

D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
   1. Pulverize masonry to maximum 1-inch (25-mm) size.
a. Crush masonry and screen to comply with requirements in Section 312000 "Earth Moving" for use as general fill.

2. Clean and stack undamaged, whole masonry units on wood pallets.

E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

F. Metals: Separate metals by type.
   1. Structural Steel: Stack members according to size, type of member, and length.
   2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

G. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

H. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

I. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.

J. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

K. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
   4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:
   1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
   2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.
C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

3.7 ATTACHMENTS
A. Form CWM-1 for construction waste identification.
B. Form CWM-2 for demolition waste identification.
C. Form CWM-3 for construction waste reduction work plan.
D. Form CWM-4 for demolition waste reduction work plan.
E. Form CWM-5 cost/revenue analysis of construction waste reduction work plan.
F. Form CWM-6 cost/revenue analysis of demolition waste reduction work plan.
G. Form CWM-7 for construction waste
H. Form CWM-8 for demolition waste.

END OF SECTION 017419
SECTION 01 77 70
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 PRE-CLOSEOUT SUBMITTALS

A. Submit required tabulations when Work reaches seventy-five percent completion; however, regardless of percent completion, submit not later than 30 days prior to the scheduled date on which Substantial Completion is required.

B. Submit tabulations of:
   1. Equipment and systems for which the specifications require demonstrations or training, indicating relevant specification sections, scheduled time and place for demonstration and training sessions, and intended audience. Adjust schedule if instructed by Designer to do so.
   2. Equipment and systems for which operating and maintenance data are required in the Operating and Maintenance Data Binders and related documents are required in the Project Data Binders.
   3. Spare parts and extra materials required, indicating the relevant specification sections, and the appropriate party to whom the items are to be delivered.

1.02 REQUEST FOR CLOSEOUT INSPECTION

A. SUBSTANTIAL COMPLETION:
   When Contractor considers Work substantially complete, Contractor shall submit to Designer:
   1. written assertion that Work is Substantially Complete;
   2. a list of items to be completed or corrected and dates scheduled for completion or correction of each item;
   3. certification that orientation and training for facility maintenance personnel is complete or written assertion that such orientation and training will be certified prior to inspection;
   4. written assertion that Operating & Maintenance Data Binders are complete and available or will be prior to inspection;
   5. when a Use and Occupancy Permit applies, a copy of the final approval(s), or written assertion that they will be complete and available prior to inspection;
   6. a draft of the application for payment corresponding to the substantial completion, with written assertion that an application for payment will be ready and submitted at the inspection;
   7. when there is Commissioning, written assertion that Commissioning requirements have been completed or will be prior to inspection.
   8. when there is a storm water permit, written statement of the status of final stabilization required under the Storm Water Pollution Prevention Plan (SWPPP) for the TDEC Construction General Permit (CGP) Notice of Termination (NOT).

B. FINAL INSPECTION:
   When Contractor considers Work complete, Contractor shall submit to Designer:
   1. certification that a qualified person authorized by Contractor has reviewed the Contract Documents and inspected the Work;
   2. written assertion that the Work is complete and in accordance with Contract Documents and ready for Final Inspection;
   3. written assertion that additional materials necessary to augment the Operating & Maintenance Data Binders with instructions for adding these to the Binders, or full replacement Binders, are complete and available or will be prior to inspection;
   4. written assertion that Project Data Binders and Construction Record Documents are complete and available or will be prior to inspection; and,
   5. an application for final payment
C. Upon receipt of an appropriate request for inspection, Designer will schedule an inspection meeting with Contractor, and Owner's representatives to determine the status of completion.

1.03 RESULTS OF CLOSEOUT INSPECTIONS

A. Should the Designer determine that Work is not complete to the degree asserted by Contractor, Designer will promptly notify Contractor in writing stating the deficiencies. Contractor shall take immediate steps to remedy deficiencies and make a request for Re-Inspection.

B. SUBSTANTIAL COMPLETION: Designer will prepare a Certificate of Substantial Completion accompanied by a list of items to be completed or corrected, and will submit Certificate to Contractor and to Owner for signature with an accounting of Liquidated Damages due, when Designer verifies that:
   1. Work is Substantially Complete based on an inspection conducted pursuant to an appropriate request for Closeout inspection;
   2. orientation and training for facility maintenance personnel is complete; and,
   3. Operating & Maintenance Data Binders are complete and have been delivered to the Owner.

C. FINAL INSPECTION: Designer will certify that the Work is Complete, and will initiate Final Adjustments, when Designer verifies that:
   1. Work is complete in accordance with Contract Documents based on an inspection conducted pursuant to an appropriate request for Closeout inspection;
   2. orientation and training for facility maintenance personnel is complete; and,
   3. additional materials necessary to augment the Operating & Maintenance Data Binders with instructions for adding these to the Binders, or full replacement Binders, are complete and have been delivered to the Owner.
   4. Project Data Binders and Construction Record Documents are complete and have been delivered to the Designer.

1.04 RE-INSPECTION FEES: If the Work fails a Closeout inspection, and a subsequent inspection is requested and conducted based on Contractor assertion of the same stage of completion, Owner will compensate Designer for performing such Re-Inspection as additional services, and deduct the amount of such compensation from the Contract Sum by appropriate modification.

1.05 FINAL ADJUSTMENTS

A. When Designer has certified that the Work is complete, Designer will determine whether modification is needed to reflect appropriate adjustments to Contract Sum which were not previously effected. If such modification is needed, Designer shall assist the Owner in its preparation and deliver it to Contractor, who in the case of a change order, shall sign and return it to Designer.

B. When Designer has certified that the Work and needed modifications to the Contract are complete, and if necessary, Designer will instruct Contractor to submit a revised final application for payment.

1.06 ONE-YEAR CORRECTIVE INSPECTION

A. An inspection will be scheduled and conducted at project site prior to one year from date Substantial Completion was achieved, but as close to the end of that year as is reasonably possible.

B. The inspection will be attended by at least one representative each of Owner, Designer, and Contractor.

C. The inspection will confirm non-conforming items previously identified for correction by the Owner, and whether corrections have been completed or are still outstanding, and is intended to be an opportunity for Contractor to become aware of any outstanding corrections needed.

END OF SECTION
SECTION 01 78 21
CLOSEOUT SUBMITTALS

PART 1 - GENERAL

1.01 DATA BINDERS GENERALLY

A. Provide two complete sets. Provide commercial quality three ring binders with durable plastic covers. Identify project and type of data on face and side of binder. If multiple binders are required, identify as consecutively numbered volumes, identifying original documents as set number one. Provide information required by Contract Documents organized as outlined below. Include related documents under the heading to which each is most closely related.

B. Provide introductory information:
   1. Cover sheet giving complete project title and number, Contractor's name, address, phone number, name of project superintendent, and related general information.
   2. Table of Contents identifying material in Binder, and identifying missing materials to be added later or certifying completeness of Binder. Reference and bind separately any over-size documents that cannot be neatly folded and included in this binder.

1.02 OPERATING & MAINTENANCE DATA BINDERS

A. Provide Product Data as outlined below
   1. Detailed Table of Contents for this part
   2. For each system or product: names, addresses, and telephone numbers of supplier, installer, and maintenance service company; drawing and specification reference; building location; manufacturer and model number
   3. Description of unit and component parts, clearly identifying the specific product or part installed. When manufacturer's cut sheets are used for product identification, plainly mark specific items included in Work and mark out items not included in Work.
   4. related information required by Contract Documents, or furnished with items included in Project, that Owner may use for maintenance, operation, repair, renovation, or additions to Work.

B. Provide Operating and Maintenance Data as outlined below for mechanical and electrical systems, equipment, and products:
   1. Detailed Table of Contents for this part
   2. Manufacturer's printed operating and maintenance instructions supplemented with drawings and text to clearly illustrate proper operation and a logical sequence of maintenance procedures.
   3. Servicing and lubrication schedule with list of lubricants.
   4. Manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
   5. As-installed control diagrams by controls manufacturer.
   6. Installers' coordination drawings with as-installed color coded piping diagrams and wiring diagrams.
   7. Charts of valve tag numbers with the location and function of each valve.
   8. Circuit directories of panel boards.
   9. Instructions for care, with a list of manufacturer's recommended types of cleaning agents and methods.
   10. List materials and parts furnished for the Owner's use.
   11. Copy of the list of persons who received demonstration and training.
C. If Commissioning applies, provide a section for the Commissioning functional performance test certifications and data. If separate binders of this information have been submitted already, include a copy of their content in this section. If separate binders of this information have not been submitted already, provide a third copy in a separate binder.

D. If a SWPPP applies, provide a section into which the Designer can add the Storm Water Operation & Maintenance Plan.

1.03 PROJECT DATA BINDERS

A. Add to introductory information a complete listing of subcontractors and material suppliers, including dollar amount, company name, address, phone number, local representative, and information regarding minority-owned business status. This information shall be submitted to Designer on the form exhibited as Section 01 78 88.

B. Provide certificates and acceptance information:
   1. Detailed Table of Contents for this part
   2. Certificate of Substantial Completion
   3. A copy of the State Fire Marshal’s Certificate of Occupancy, if applicable
   4. Other Certificate(s) of Inspection, Use & Occupancy permit, or letter(s) of acceptance from:
      a. Local building authorities
      b. Department of Labor for boilers, pressure vessels, or elevators
      c. Public Health Authorities
      d. other governing authorities as apply

C. Guarantees, warranties, bonds, certifications, maintenance agreements, and related documents
   1. Detailed Table of Contents for this part
   2. Guarantees, warranties, and bonds, executed by the respective vendors, manufacturers, suppliers and subcontractors
   3. Certifications
   4. Maintenance Agreements and service contracts
   5. Complete information for each item:
      a. Product or work item, and scope of installation
      b. Name of provider, with name of responsible principal, address and telephone number
      c. Beginning date and duration
      d. Information about instances which might affect validity, and proper procedure in case of failure

D. If a SWPPP applies, provide the twice-weekly inspection reports and site audit reports.

1.04 CONSTRUCTION RECORD DOCUMENTS: The record copy of Contract Documents required by paragraph 3.11 of the Conditions shall be kept in good condition for submittal to Designer upon completion of construction activity. In the course of the Work, Contractor shall legibly mark these documents to record actual conditions of Work, including: location, depth, and identification of new and existing underground items, location by dimension and identification of utilities, valves, tap points, equipment, service access, test points, and related features, field changes in dimensions and detail, changes by addenda, change orders, and construction change directives, description and details of features for maintenance, service, replacement, or expansion of the Work.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED SECTIONS
Section 01 29 76 Payment Procedures
Section 01 77 70 Close-Out Procedures
Section 01 78 21 Close-Out Submittals

1.02 CONTRACTOR PREPARATION AND USE OF THIS FORM

A. Use this form or a reasonable facsimile to verify delivery of Data Binders. Fill in the identifying information following this paragraph, then use the prepared form as a receipt, for signature by the person to whom Data Binders are delivered. Provide a copy of the receipt with the application for payment.

1. For the Application for Payment commensurate with Substantial Completion, provide a copy indicating delivery of Operating and Maintenance Data Binders.

2. For the Application for Payment commensurate with Final Completion, provide a copy indicating delivery of Project Data Binders.

B. Identifying Information:
1. For the Work:
   Project Title:
   (SBC project number, institutional location, and work name)

2. For the Data Binder(s), mark only one of the boxes below:
   - ONLY Operating & Maintenance Data Binder
     (due at substantial completion inspection)
   - ONLY Project Data Binder
     (due at final inspection)
   - BOTH data binders

1.03 RECIPIENT SIGNATURE

A. By signature below, recipient acknowledges receipt of the Data Binder identified above, but does not certify the completeness or correctness of the Data Binder.

Recipient Signature:
Legibly indicate recipient’s name and title or affiliation with Owner or Designer

END OF SECTION
SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:
   1. Section 017300 "Execution" for final property survey.
   2. Section 017700 "Closeout Procedures" for general closeout procedures.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set of marked-up record prints.
   1) Submit paper-copy set of marked-up record drawings.
      OR
   2) Submit PDF electronic files of scanned record drawings.
      OR
   3) Submit annotated PDF electronic file of record drawings.

2. Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

B. Record Specifications: Submit one paper copy or annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

C. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.
PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Drawings: Maintain one set of marked-up paper copy of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record drawings to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record drawings.
   a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
   b. Accurately record information in an acceptable drawing technique.
   c. Record data as soon as possible after obtaining it.
   d. Record and check the markup before enclosing concealed installations.
   e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:
   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations below first floor.
   d. Locations, identifications, and depths of new and existing underground utilities and other underground items
   e. location by dimension and identification of utilities, valves, tap points, equipment, service access, test points, and related features
   f. description and details of features for maintenance, service, replacement, or expansion of the Work
   g. Revisions to routing of piping and conduits.
   h. Revisions to electrical circuitry.
   i. Actual equipment locations.
   j. Duct size and routing.
   k. Locations of concealed internal utilities.
   l. Changes made by Addenda, Change Order, or Construction Change Directive.
   m. Changes made following Architect's written orders.
   n. Details not on the original Contract Drawings.
   o. Field records for variable and concealed conditions.
   p. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.

4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Markup of paper copy or Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS."
   d. Name of Architect.
   e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.

B. Format: Submit record Specifications as annotated PDF electronic file or scanned PDF electronic file of marked-up paper copy of Specifications.

2.3 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.
PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 01 78 39
SECTION 01 78 53 - SUSTAINABLE DESIGN CLOSEOUT DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Procedures for closeout submittals.
      a. Record Documents.
      b. Warranties.
      d. Maintenance materials
   2. Procedural and administrative requirements for substantial completion and final inspection.

1.2 CLOSEOUT SUBMITTALS

A. Record Documents.
   1. Environmental Record Documents: As specified in Divisions 01 – 34 and as follows:
      a. Demonstration and Training Verification: As specified in 01 79 25 - Demonstration and Training Verification
      b. Commissioning Report: As specified in Section 01 91 13 - Commissioning.
      c. Performance Testing Identification Form: As specified in Section 01 91 23 - Performance Testing Identification Form.
      d. Performance Testing Procedures Form: As specified in Section 01 91 26 - Performance Testing Procedures Form.
      e. Functional Performance Test Certification: As specified in Section 01 91 29 - Functional Performance Test Certification.

B. Warranties.

C. Operations and Maintenance Manual: Include the following:
   1. Operations and Maintenance Data: As specified in Section 01 78 23 – Operation and Maintenance Data.

D. Maintenance materials: Submit as specified in Section 01 78 23.

1.3 SUBSTANTIAL COMPLETION

A. Prior to notifying the Architect that the project is complete according to the Contract Documents:
   1. Submit approved pre-functional checklists and functional performance testing reports from the commissioning documentation.
      a. Equipment start-up requires coordination with the commissioning process. Refer to Section 01 91 13. Equipment shall not be “temporarily” started for commissioning.
1.4 FINAL ACCEPTANCE

A. Prior to requesting inspection for verification of completion of all outstanding items:
   1. Complete commissioning requirements of Section 01 91 13, unless approved in writing by the Owner. Exceptions to this are required seasonal and approved deferred testing.
   2. Submit signed checklist in Section 01 78 56.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 78 53
## Project Close-Out and Credit Verification Form

### Sustainable Design Guidelines

In accordance with the State Architect's office, a copy of this form must accompany required Project Closeout documents. Acceptance by the State Project Manager is required upon review of completed Credit Verification Form.

### Project Title: ETSU IPER Center (CoM Building 60)

<table>
<thead>
<tr>
<th>SBC No: 166/005-06-2013</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>O</strong></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>State Project Manager: (Keith King, Tennessee Board of Regents) Sign Above</th>
<th>Date Above</th>
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<tbody>
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</table>

<table>
<thead>
<tr>
<th>Designer: [David Cockrill, Red Chair Architects] Sign Above</th>
<th>Date Above</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Contractor: [Nick Self, Burwil Construction] Sign Above</th>
<th>Date Above</th>
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### TN SDG Credit

<table>
<thead>
<tr>
<th>Credit A. Land Management</th>
<th>Credit Level</th>
<th>Sign-Off (O/D/C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1.02-A-1-a Re-use Existing Buildings</td>
<td>Optional</td>
<td>O</td>
</tr>
<tr>
<td>1 1.02-A-1-b Site Selection - Show preference for building on developed sites. Preserve land classified as farmland or habitat, wetlands, and floodplains</td>
<td>Recommended</td>
<td>O</td>
</tr>
<tr>
<td>0 1.02-A-1-c Brownfield Redevelopment - Remediate/restore contaminated/brownfield sites when possible</td>
<td>Optional</td>
<td>N/A</td>
</tr>
<tr>
<td>1 1.02-A-1-d Building Orientation - Orient building on site for maximum solar use</td>
<td>Recommended</td>
<td>D</td>
</tr>
<tr>
<td>1 1.02-A-1-e Urban Development - Locate building within existing infrastructure</td>
<td>Recommended</td>
<td>O</td>
</tr>
<tr>
<td>1 1.02-A-2-a Site Disturbance - Erosion and sediment control during construction</td>
<td>Required</td>
<td>C</td>
</tr>
<tr>
<td>1 1.02-A-2-b Site Disturbance - Limit site disturbance during construction to minimum development footprint</td>
<td>Required</td>
<td>C</td>
</tr>
<tr>
<td>0 1.02-A-3-a Transportation - Plan for access to public transportation</td>
<td>Optional</td>
<td>N/A</td>
</tr>
<tr>
<td>0 1.02-A-3-b Transportation - Provide bicycle storage for 5% and shower/changing facilities for 0.5% of the building occupants</td>
<td>Optional</td>
<td>N/A</td>
</tr>
<tr>
<td>0 1.02-A-3-c Transportation - Plan site to include preferred parking for carpooling for 5% of all parking spaces</td>
<td>Optional</td>
<td>N/A</td>
</tr>
<tr>
<td>0 1.02-A-3-d Transportation - Plan site to include preferred parking for alternative fuel vehicles for 5% of all parking spaces</td>
<td>Optional</td>
<td>N/A</td>
</tr>
<tr>
<td>1 1.02-A-4-a Landscape Design - Maximize vegetated open space</td>
<td>Optional</td>
<td>D</td>
</tr>
<tr>
<td>1 1.02-A-4-b Landscape Design - Native and climate-tolerant planting</td>
<td>Required</td>
<td>D</td>
</tr>
<tr>
<td>1 1.02-A-4-c Heat Island Reduction - Site surface reflectivity and shading</td>
<td>Recommended</td>
<td>D</td>
</tr>
<tr>
<td>0 1.02-A-5-b Heat Island Reduction - Reflective or vegetated roof surfaces</td>
<td>Optional</td>
<td>N/A</td>
</tr>
<tr>
<td>1 1.02-A-5-c Stormwater Design - Post-development discharge rate not to exceed pre-development rate</td>
<td>Recommended</td>
<td>D</td>
</tr>
<tr>
<td>0 1.02-A-6-a Stormwater Design - Reduce discharge rate 25% on previously developed sites.</td>
<td>Recommended</td>
<td>N/A</td>
</tr>
<tr>
<td>0 1.02-A-6-b Stormwater Design - Design to remove 80% Total Suspended Solids from the first inch of rain per each rainfall event. Verify local requirements.</td>
<td>Recommended</td>
<td>N/A</td>
</tr>
<tr>
<td>1 1.02-A-6-c Stormwater Design - Design per TDEC BMP References</td>
<td>Required</td>
<td>D</td>
</tr>
<tr>
<td>1 1.02-A-7-a Exterior Site Lighting - Design exterior power densities not to exceed ASHRAE 90.1-2007</td>
<td>Optional</td>
<td>D</td>
</tr>
<tr>
<td>1 1.02-A-7-b Exterior Site Lighting - Design building façade lighting to be 50% less than power densities defined by ASHRAE 90.1-2007</td>
<td>Optional</td>
<td>D</td>
</tr>
<tr>
<td>0 1.02-A-7-c Exterior Site Lighting - Locate fixtures to minimize illuminance above the horizontal plane and to minimize light trespass at site boundary</td>
<td>Recommended</td>
<td>N/A</td>
</tr>
<tr>
<td>0 1.02-A-7-d Exterior Site Lighting - Design using &quot;cutoff&quot; and &quot;full cutoff&quot; styles to minimize 90 degree directional light.</td>
<td>Recommended</td>
<td>N/A</td>
</tr>
<tr>
<td>0 1.02-A-7-d Exterior Site Lighting - Locate exterior fixtures to minimize light trespass at site boundary</td>
<td>Recommended</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### SDG Points Achieved

43
### Project Close-Out and Credit Verification Form

**Sustainable Design Guidelines**

In accordance with the State Architect's office, a copy of this form must accompany required Project Closeout documents. Acceptance by the State Project Manager is required upon review of completed Credit Verification Form.

#### B. Water Efficiency

<table>
<thead>
<tr>
<th>TN SDG</th>
<th>Credit</th>
<th>Credit Level</th>
<th>Sign-Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.02 B-1-a</td>
<td>Wastewater Treatment &amp; Conveyance: On-site treatment</td>
<td>Optional</td>
</tr>
<tr>
<td>0</td>
<td>1.02 B-1-b</td>
<td>Wastewater Treatment &amp; Conveyance: Use of non-potable water</td>
<td>Optional</td>
</tr>
<tr>
<td>1</td>
<td>1.02 B-2-a</td>
<td>Water Use Reduction - Fixture flow rates</td>
<td>Required</td>
</tr>
<tr>
<td>1</td>
<td>1.02 B-2-b</td>
<td>Water Use Reduction - Use of auto-flow/auto-flush valves</td>
<td>Optional</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>Water Efficient Landscaping, Non-potable sources or no irrigation</td>
<td>Recommended</td>
</tr>
<tr>
<td>1</td>
<td>1.02 B-2-c</td>
<td>Water Efficient Landscaping, Utilize efficient irrigation technologies and planting measures</td>
<td>Required</td>
</tr>
</tbody>
</table>

#### C. Energy Efficiency and Atmosphere Protection

<table>
<thead>
<tr>
<th>TN SDG</th>
<th>Credit</th>
<th>Credit Level</th>
<th>Sign-Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.02 C-1-a</td>
<td>Commissioning - Determine commissioning scope appropriate to project</td>
<td>Required</td>
</tr>
<tr>
<td>1</td>
<td>1.02 C-1-b</td>
<td>Commissioning - Basic commissioning process</td>
<td>Required</td>
</tr>
<tr>
<td>1</td>
<td>1.02 C-1-c</td>
<td>Commissioning - Enhanced commissioning process</td>
<td>Recommended</td>
</tr>
<tr>
<td>1</td>
<td>1.02 C-2-a</td>
<td>Energy Efficiency of Building Systems - Meet mandatory and prescriptive requirements of ASHRAE Standard 90.1-2007</td>
<td>Required</td>
</tr>
<tr>
<td>1</td>
<td>1.02 C-2-b</td>
<td>Energy Efficiency of Building Systems - Conceptual Energy Modeling</td>
<td>Required</td>
</tr>
<tr>
<td>0</td>
<td>1.02 C-2-c</td>
<td>Energy Efficiency of Building Systems - Perform full comparison energy model to demonstrate compliance with ASHRAE Standard 90.1-2007</td>
<td>Optional</td>
</tr>
<tr>
<td>1</td>
<td>1.02 C-3-a-i</td>
<td>Refrigerant management - No CFCs</td>
<td>Required</td>
</tr>
<tr>
<td>1</td>
<td>1.02 C-3-a-ii</td>
<td>Refrigerant management - HCFCs and HFCs requirements</td>
<td>Recommended</td>
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<tr>
<td>1</td>
<td>1.02 C-4</td>
<td>Instrumentation and Measurement - Install instrumentation to monitor building energy use</td>
<td>Optional</td>
</tr>
<tr>
<td>0</td>
<td>1.02 C-5</td>
<td>Onsite Renewable Energy - Evaluate on-site renewable energy opportunities</td>
<td>Optional</td>
</tr>
<tr>
<td>0</td>
<td>1.02 C-6</td>
<td>Green Power - Provide 35% from grid source renewable energy or 10% through TVA's Green Power Switch program</td>
<td>Optional</td>
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</table>

#### D. Material and Resource Use

<table>
<thead>
<tr>
<th>TN SDG</th>
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<th>Credit Level</th>
<th>Sign-Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.02 D-1</td>
<td>Recyclable Collection &amp; Storage</td>
<td>Required</td>
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<tr>
<td>1</td>
<td>1.02 D-2</td>
<td>Construction Waste Management</td>
<td>Recommended</td>
</tr>
<tr>
<td>1</td>
<td>1.02 D-3-a</td>
<td>Sustainable Materials: Recycled Content 5%</td>
<td>Required</td>
</tr>
<tr>
<td>0</td>
<td>1.02 D-3-a</td>
<td>Sustainable Materials: Recycled Content 10%</td>
<td>Optional</td>
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<tr>
<td>0</td>
<td>1.02 D-3-b</td>
<td>Sustainable Materials: Rapidly renewable materials</td>
<td>Optional</td>
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<tr>
<td>0</td>
<td>1.02 D-3-c</td>
<td>Sustainable Materials: FSC certified wood</td>
<td>Optional</td>
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<tr>
<td>1</td>
<td>1.02 D-3-d</td>
<td>Sustainable Materials: Salvaged materials</td>
<td>Optional</td>
</tr>
</tbody>
</table>
### Project Close-Out and Credit Verification Form

**Sustainable Design Guidelines**

In accordance with the State Architect's office, a copy of this form must accompany required Project Closeout documents. Acceptance by the State Project Manager is required upon review of completed Credit Verification Form.

<table>
<thead>
<tr>
<th>TN SDG</th>
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<th>Credit Description</th>
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<td>E. Indoor Environmental Quality</td>
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<td>1.02-E-1</td>
<td>Non-Smoking Facilities</td>
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<td>O</td>
</tr>
<tr>
<td>1</td>
<td>1.02-E-2</td>
<td>Ventilation: Design to meet ASHRAE 62.1-2007</td>
<td>Required</td>
<td>D</td>
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<tr>
<td>0</td>
<td>1.02-E-3-a</td>
<td>Outdoor Air Delivery Monitoring: Monitor mechanical delivery rate with an accuracy of 15%</td>
<td>Optional</td>
<td>N/A</td>
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<tr>
<td>1</td>
<td>1.02-E-3-b</td>
<td>CO2 Monitoring: Provide CO2 monitors in all densely occupied spaces</td>
<td>Optional</td>
<td>D</td>
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<tr>
<td>1</td>
<td>1.02-E-4</td>
<td>Air Quality Management: During construction</td>
<td>Recommended</td>
<td>C</td>
</tr>
<tr>
<td>0</td>
<td>1.02-E-5</td>
<td>Air Quality Management: Before occupancy</td>
<td>Optional</td>
<td>N/A</td>
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<tr>
<td>1</td>
<td>1.02-E-6-a</td>
<td>Material VOC Limits: Adhesives and sealants</td>
<td>Required</td>
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<td>1</td>
<td>1.02-E-6-b</td>
<td>Material VOC Limits: Paints</td>
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<td>1</td>
<td>1.02-E-6-c</td>
<td>Material VOC Limits: Anti-corrosives and coatings</td>
<td>Required</td>
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<td>1</td>
<td>1.02-E-6-d</td>
<td>Material VOC Limits: Carpets</td>
<td>Required</td>
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<tr>
<td>1</td>
<td>1.02-E-6-e</td>
<td>Material VOC Limits: Composite wood and agrifiber</td>
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<td>1</td>
<td>1.02-E-7-a</td>
<td>Pollutant Control: Entryway systems</td>
<td>Required</td>
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<td>1</td>
<td>1.02-E-7-b</td>
<td>Pollutant Control: Hazardous material storage exhaust</td>
<td>Required</td>
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<td>1.02-E-7-c</td>
<td>Pollutant Control: Filtration media</td>
<td>Recommended</td>
<td>N/A</td>
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<td>1</td>
<td>1.02-E-8</td>
<td>Thermal Comfort: Meet ASHRAE Standard 55-2004</td>
<td>Required</td>
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<td>1.02-E-9-a</td>
<td>Occupant System Controls: Thermal Comfort</td>
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<td>1.02-E-9-b</td>
<td>Occupant System Controls: Lighting Controls</td>
<td>Optional</td>
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<td>0</td>
<td>1.02-E-10</td>
<td>Daylight to Occupied spaces</td>
<td>Recommended</td>
<td>N/A</td>
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<td>0</td>
<td>1.02-E-11</td>
<td>Views from Occupied spaces</td>
<td>Recommended</td>
<td>N/A</td>
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<table>
<thead>
<tr>
<th>TN SDG</th>
<th>Credit</th>
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<tr>
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<td>F. Tennessee Advancement</td>
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<td>1.02-F-1</td>
<td>Innovation in Design: Provide Specific Title</td>
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<td>1.02-F-1</td>
<td>Innovation in Design: Provide Specific Title</td>
<td>Optional</td>
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<td>1.02-F-1</td>
<td>Innovation in Design: Provide Specific Title</td>
<td>Optional</td>
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<td>1.02-F-1</td>
<td>Innovation in Design: Provide Specific Title</td>
<td>Optional</td>
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<td>1.02-F-2</td>
<td>Environmentally Accredited Design Team</td>
<td>Recommended</td>
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Total SDG Points Achieved by Project: 43
# SECTION 01 78 88
## REPORT OF SUBCONTRACTORS AND SUPPLIERS

<table>
<thead>
<tr>
<th>Project</th>
<th>SBC Project Number</th>
<th>Page</th>
</tr>
</thead>
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</tbody>
</table>

Use first entry on first page for General Contractor

<table>
<thead>
<tr>
<th>Work performed or Material Supplied, and Dollar Value</th>
<th>Firm name and address</th>
<th>Principal Contact and Phone</th>
<th>If a Minority-Owned Business, classification and certifying agency. If not, “NO”.</th>
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</tr>
</tbody>
</table>
PART 1 - GENERAL: not used

PART 2 - PRODUCTS: not used

PART 3 - EXECUTION

3.01 Equipment Start-up / Commissioning

A. Conduct demonstration and instruction as soon as practicable upon installations, and prior to Substantial Completion inspection. Substantial Completion shall not be certified, nor shall Owner be required to assume responsibility for operating, maintaining, or insuring system, prior to complete demonstration and instruction.

B. Demonstrate operation of newly provided equipment and systems to Designer and to Owner's representative. Instruct Owner's personnel in operation, adjustment, and maintenance of equipment and systems, using the operating and maintenance data as the basis of instruction.

C. Make lists of persons witnessing equipment and systems demonstration, and persons receiving operating instruction, using a format similar to the form included in Section 01 79 25 with project, subject, trainer, session information, and attendees identified. Include copy of lists in the Operating and Maintenance Data Binders.

END OF SECTION
PART 1 – GENERAL

1.01 Use a copy of this page as a planning form for demonstrations and training. Fill in the basic identifying information below:

- **SBC Project Number:**
- **Institution/Location:**
- **Project Name:**
- **Owner’s Facility Coordinator:**
- **Owner’s Maintenance Contact:**
- **Contractor Contact:**
- **Required date of Substantial Completion:**

1.02 If a list of required demonstrations and training has been specified in Division 1, use that list as a starting point, review the project manual for other specifications that require training of the Owner’s operators, and complete the list below. Check the box on left if Demonstration and Training is required on the standard listed subjects; add subjects as identified by review of the specifications and check the box to the left of each; and, schedule and indicate an target date for each. If the number of training subjects exceeds the available space provided here, replace or continue the list on a similarly formatted separate page. Submit the list with the initial Progress Schedule, and update as necessary during the Work to ensure that advance notice of the demonstration and training schedule is acceptable to the Designer.

<table>
<thead>
<tr>
<th>Spec Reference</th>
<th>Subject</th>
<th>Target Date</th>
<th>Actual Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Accessibility</td>
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<tr>
<td></td>
<td>Boiler</td>
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<td>Chiller</td>
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<td></td>
<td>Controls</td>
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<td>Data Transmission</td>
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<td>Elevator / Conveying</td>
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<td>Irrigation</td>
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<td>Plumbing</td>
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<td></td>
<td>Telecommunications</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PART 2 – PRODUCTS: not used.

PART 3 – EXECUTION

3.01 For each session conducted, use this page as a Training Verification Report.

A. Fill in the information below prior to the session (“End Time” may be filled in after):

SBC Project Number: __________________________

Institution/Location: __________________________

Project Name: ________________________________

Subject Equipment / System:

Spec Reference

<table>
<thead>
<tr>
<th>Demonstration and Training (by whom, where, when)</th>
<th>Trainer Name:</th>
<th>Company:</th>
<th>Phone:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place:</td>
<td>Date:</td>
<td>Start Time:</td>
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B. Minimum Agenda Requirements:

☐ System Walk-through  ☐ Operation  ☐ Trouble-shooting  ☐ Maintenance  ☐ Safety

C. Attendance: Each person receiving the demonstration and training shall sign in below, or on a similarly formatted continuation page:

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<tr>
<th>Initials</th>
<th>Legibly print your name</th>
<th>Unit and title or function</th>
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END OF SECTION
SECTION 01 91 13 - COMMISSIONING

PART 1 - GENERAL

1.1 SUMMARY

A. Commissioning is a quality-focused process for enhancing the delivery of a project. The process focuses on verifying and documenting that the facility and all its systems and assemblies are planned, designed, installed, tested, operated and maintained to meet the Owner’s Operational Performance Requirements as defined in the Contract Documents.

B. The purpose of commissioning is to provide a systematic process of assuring by verification and documentation, from the design phase to a minimum of one year after construction, that all facility systems perform interactively in accordance with the Contract Documents and their intent.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification Section 01 91 29 – Functional Performance Test Certification

C. Specification Section 22 08 00 – Plumbing Systems Commissioning

D. Specification Section 23 08 00 – Mechanical & Control Systems Commissioning

E. Specification Section 26 08 00 – Electrical & Lighting Systems Commissioning

F. Commissioning Plan (to be provided in Construction Phase containing process workflows, communication protocols, project-specific equipment checklists and project-specific functional performance test procedures)

1.3 INCLUDED SYSTEMS

A. The following systems, equipment and their components are included in the scope of the commissioning activities and are considered to be commissioned systems and equipment.

1. Heating, Ventilating and Air Conditioning (HVAC) Systems

2. Plumbing Systems

3. Building Automation and Control System (BACS)

4. Lighting (Interior and Exterior) Systems

5. Electrical Power Systems
6. Fire Alarm

1.4 ROLES AND RESPONSIBILITIES

A. Commissioning Authority (CxA): The Commissioning Authority is an individual who guides, reviews and orchestrates the completion of the commissioning process activities.

B. General Contractor (hereafter referred to as “Contractor”)

1. The Contractor shall be responsible for adhering to applicable code required procedures, standards and industry practices to ensure personal safety, the safety of others, and facility safety. If there are procedures in the checklists or the functional performance tests which conflict with safety, the Contractor shall not proceed and shall notify the CxA immediately.

2. The Contractor shall be responsible for the quality of construction.

3. The Contractor shall be responsible for communicating to the CxA the construction schedule, milestones, completion schedules, planned testing, etc., including updates in the same fashion, timeliness and level of detail as is provided to the Owner.

4. The Contractor shall incorporate commissioning-related activities into the overall project schedule.

5. The Contractor shall make record drawings readily available for review and use by the CxA at any time during normal business hours.

C. Subcontractors

1. The HVAC Subcontractor shall be responsible for the scheduling, supervising and performing start-up, testing and commissioning activities as necessary to demonstrate to the Owner successful operation of the HVAC systems.

2. The Plumbing Subcontractor shall be responsible for the scheduling, supervising and performing start-up, testing and commissioning activities as necessary to demonstrate to the Owner successful operation of the plumbing systems.

3. The BACS Subcontractor shall be responsible for the scheduling, supervising and performing start-up, testing and commissioning activities as necessary to demonstrate to the Owner successful operation of the BACS.

4. The Electrical Subcontractor shall be responsible for the scheduling, supervising and performing start-up, testing and commissioning activities as necessary to demonstrate to the Owner successful operation of the electrical systems.

PART 2 - PRODUCTS

2.1 MEANS OF ACCESS

A. The Contractor and/or Subcontractors shall provide means for the CxA to access, observe and visually confirm proper operation of all equipment and systems. These means shall be in compliance with all OSHA
and job-site safety regulations.

2.2 TEST EQUIPMENT

A. The Contractor and/or Subcontractors shall provide the necessary equipment to fully test the commissioned systems as defined in the functional performance test procedures to be provided by the CxA.

B. The test equipment shall meet the following minimum requirements.
   1. All test equipment shall be in good mechanical and electrical condition.
   2. Field test metering used to check power system meter calibration will be more accurate than the instrument being tested.
   3. Accuracy of metering in test equipment shall be appropriate for the test being performed.
   4. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and the tested equipment.

C. Calibration
   1. Calibration of all test equipment shall be current.
   2. Calibration accuracy shall be traceable to National Institute of Standards and Technology (NIST).
   3. Test equipment shall be calibrated in accordance with the following schedule.
      a. Field instruments
         1) Analog – At least every 6 months
         2) Digital – At least every 12 months
      b. Leased Specialty Equipment – At least every 12 months
   4. Dated calibration labels shall be visible on all test equipment.
   5. Calibration records shall be provided for all test equipment used in the project.

PART 3 EXECUTION

3.1 COMMISSIONING TEAM

A. The Contractor and each Subcontractor shall designate an individual to be responsible for coordinating commissioning activities with the CxA. This requirement is intended to facilitate effective communication during the commissioning process.

B. The commissioning team consists, at a minimum of the following:
   1. Tennessee Board of Regents
   2. East Tennessee State University
3. Commissioning Authority

4. Architect

5. Design Engineers (Mechanical, Plumbing, Electrical, Specialty)

6. General Contractor

7. Mechanical Subcontractor(s) and its Subcontractors

8. Plumbing Subcontractor(s) and its Subcontractors

9. BACS Subcontractor(s) and its Subcontractors

10. Electrical Subcontractor(s) and its Subcontractors

11. TAB Subcontractor

3.2 COMMUNICATION PROTOCOLS

A. Formal reports including Site Observation Reports will be distributed to the Owner, Developer, Architect and General Contractor.

B. Informal comments and observations from the commissioning work will be relayed directly to the responsible party whenever possible, with copies to the Owner, Developer, Architect and General Contractor. This includes field observations and functional performance test results. The direct communication approach will avoid delays from traditional remote paper exchanges, will encourage dialogue and discussion of options and alternatives, and generally maintain an atmosphere of cooperation and quality.

C. Response Times

1. Timeliness in delivering information or providing responses to the CxA is essential to providing the construction product to the Owner on time, as well as facilitating the commissioning process.

2. The Contractor shall adhere to the following to meet this objective:
   a. Delivery of proposed training material to CxA: Thirty (30) days prior to the scheduled training
   b. Written response to a site observation comment to CxA: Five (5) days or less from receipt of comment, if possible.
   c. Time to correct discrepancies noted in Record Drawings during construction phase: Two (2) weeks from the date the discrepancy was noted

3. The CxA shall respond, in writing, to questions from the Contractor within five (5) working days.

3.3 COMMISSIONING MEETINGS

A. Commissioning issues will be handled during project meetings which will be scheduled bi-weekly or less, unless agreed to by both the CxA and Contractor. If specific topics require additional discussion, the appropriate parties shall meet immediately after the project meeting or at another time mutually agreed to by those parties.
3.4 SUBMITTAL REVIEW PROCEDURES

A. The Contractor shall provide a copy of each submittal defined for the systems to be commissioned to the CxA at the same time as providing the submittal to the Architect.

B. The CxA will review the submittals for information only (approval not required) parallel to the Engineer’s review.

3.5 FIELD OBSERVATIONS AND VERIFICATIONS

A. The CxA will make field observations from time-to-time. The CxA field observation reports may include construction issues, access and maintenance issues, safety issues, or other issues.

B. The Contractor shall respond, in writing to the CxA and/or the Owner, to each contractor-responsible issue within five (5) calendar days of receipt of the field observation report. The response shall state at a minimum the following:
   1. Concurrence or not on whether this is an issue
   2. Planned corrective action
   3. Date on when correction will be completed

C. The Contractor shall respond in writing when the corrective action has been completed and in its opinion the issue is resolved.

3.6 EQUIPMENT CHECKLISTS

A. The Commissioning Authority will provide the Contractor the following types of equipment checklists (alternatively, the Contractor may submit its own checklists to the CxA for review and approval in lieu of using those provided by the CxA):
   1. Equipment Receipt Inspection Checklists
   2. Equipment Pre-functional Checklist

B. Intent
   1. The Equipment Receipt Inspection Checklist will be used to document the proper equipment was received on-site and is in suitable condition for installation on the project.
   2. The Equipment Pre-functional Checklist will be used to communicate the readiness for a particular equipment or system for functional performance testing.
   3. The checklists do not contain all of the requirements of the Contract Documents. The completion of the checklist does not eliminate the Contractor’s responsibility for meeting other requirements in the Contract Documents.
C. Use and Process

1. Equipment checklists will be provided to the Contractor by the CxA for all equipment to be commissioned.

2. The Contractor shall refer to CxAlloy to obtain the checklists.

3. The Contractor shall complete each checklist at CxAlloy. The Contractor shall document and explain any negative responses to any line item of the checklist at the end of the checklist.

4. The Contractor shall provide each completed checklist to the CxA according to the following schedule:
   a. Equipment Pre-functional Checklist: Minimum of five (5) working days prior to scheduling of any functional performance tests related to that equipment

5. The CxA shall have a minimum of five (5) working days to verify at his discretion whether the checklists have been completed satisfactorily before scheduling of any functional performance tests related to that equipment.

3.7 FUNCTIONAL PERFORMANCE TESTING

A. General

1. The Contractor and appropriate Subcontractors shall demonstrate that the commissioned equipment and systems operate properly in all modes of operation.

2. Testing shall begin at the component level and progress upwards in complexity to the equipment and system level.

3. When all systems have passed their functional performance tests, the Contractor and appropriate Subcontractors shall demonstrate that the systems operate correctly as a whole in a System Integration Test.

B. Functional Performance Test (FPT) Procedures

1. The Contractor shall provide all documentation as requested to the CxA for development of functional performance testing procedures. This documentation shall include, at a minimum, manufacturer installation, start-up, operation and maintenance procedures. The CxA may request further documentation as necessary for the development of functional performance tests.

2. The FPT procedures will be provided to the Contractor by the CxA prior to testing for review.

3. The Contractor shall refer to the Commissioning Plan for draft FPT procedures.

4. The Contractor and Subcontractors shall review the FPT procedures and reply, in writing, whether the tests as written are acceptable, meet the installed conditions, and will not void any warranties. The Contractor shall provide any requested modifications to the test procedures in writing to the CxA for consideration. No reply from the Contractor within four (4) weeks of its receipt of the FPT procedures signifies the Contractor's and Subcontractors' concurrence that the procedures are acceptable.
5. The FPT procedures will provide step-by-step instructions in a pass/fail format.

C. When the equipment and systems are ready to test, the FPT will be scheduled for a time in accordance with the project completion schedule.

1. Functional performance testing is intended to begin upon completion of a system.

2. Functional testing may proceed prior to the completion of the system at the discretion of the CxA and the Contractor.

D. The Contractor shall place equipment and systems into operation and continue the operation as required during each working day of the testing activities.

E. The Contractor shall accomplish the functional performance testing of equipment based on procedures developed by the CxA and as reviewed by the Contractor.

1. The Contractor shall provide skilled technicians to operate the systems during functional performance testing. At a minimum, the contractor shall provide one trade technician familiar with the system being tested.

2. The Contractor shall provide means of access to the CxA to visually verify all aspects of the specified test.

3. The Contractor shall correct any deficiencies identified during testing and retest equipment as required.

4. Upon completion of each functional performance test, the Contractor shall provide a completed Functional Performance Test Certification form (see Specification Section 01 91 29). The Installer, General Contractor and Designers representatives, who observed the testing, will sign the Functional Performance Test Certification form.

F. If the total time required to correct minor problems during testing is greater than forty-five (45) minutes (unless extenuating circumstances exist), the test shall be considered failed and must be repeated in its entirety.

G. If a major problem is discovered during the test, the Contractor shall correct the problem. Prior to retesting, the Contractor shall submit to the CxA the required data indicating that the deficient items have been corrected. After review of this information by the CxA, a retest will be scheduled. During the course of the retest, if at any point a major deficiency is discovered, the test will be stopped. If more than two functional performance tests (one initial test and one retest) for any type of equipment due to Contractor’s failure of problems or issues that the Contractor had direct or indirect control over are required, the costs for the CxA to witness retesting of similar types of equipment until satisfactory results are obtained shall be the responsibility of the Contractor.

1. A major problem is any problem or group of problems that require more than forty-five minutes to correct.

2. A type of equipment is equipment that belongs to a common category, for example, air handling unit or panelboard.

H. Re-testing: During the course of the retest, if at any point a major deficiency is discovered, the test will be
stopped. Repeat tests until acceptable results are achieved.

I. Deferred Testing: The Contractor shall provide labor, equipment and materials to perform any functional testing that must be deferred past the date of final completion in order to properly perform the test. Acceptable reasons for deferring a test shall include the following:

1. Specific climatic conditions are necessary to properly demonstrate the functionality of the equipment or system.

2. Work to be conducted under a subsequent phase of the Project is not complete per the contractual Detailed CPM Project Schedule.

3.8 TEST AND BALANCE VERIFICATION

A. The Contractor shall provide the labor and test equipment necessary to demonstrate to the CxA that the HVAC air and water systems have been properly balanced.

B. The CxA will randomly select devices, equipment and systems for verification purposes.

1. The Contractor shall be prepared to demonstrate proper balance of at least 10% of non-critical systems. Non-critical systems are those whose sole purpose is to maintain thermal comfort conditions.

2. The Contractor shall be prepared to demonstrate proper balance of 100% of critical systems. Critical systems are those whose primary purpose is to maintain conditions necessary for life-safety or other regulatory conditions, i.e., pressure relationships in laboratories.

C. The Contractor shall regard this verification process as a functional performance test for purposes of time allowed to correct deficiencies and requirements regarding retesting if major problems are discovered.

3.9 TRAINING VERIFICATION

A. The Contractor shall submit proposed training material to the CxA for review and comment.

B. The Contractor for the respective system shall be responsible for the development and implementation of the training material for that system.

C. The Contractor shall upload final Operation and Maintenance (O&M) manuals, approved submittals, warranty document and TAB report to CxAloy prior to training.

D. At a minimum, the Contractor shall provide the following material at the time of training:

   1. Detailed agenda
   2. Contractor contact information sheet
   3. Detailed training material (divided by sections where appropriate)
   4. Log sheets and maintenance checklists
5. Training may be recorded for future reference if requested by the Owner.

E. The Contractor shall develop a proposed training schedule and submit that to the Owner for review, comment and approval.

F. The Contractor shall schedule and coordinate all training sessions through the Owner.

G. At a minimum, training topics shall include the following:

1. Description of equipment and systems
2. Warranties and guarantees
3. Equipment start-up and shutdown
4. Normal and emergency operation
5. Seasonal changeover
6. Maintenance schedules
7. Health and safety issues
8. Special tools and spare parts
9. Emergency procedures
10. Hands-on operation
11. Troubleshooting
12. O&M manuals
13. Facilities control system and sequences of operation

END OF SECTION 01 91 13
### Performance Testing Identification Form

**Owner's Project Number:** 166/

**Institution or Campus:**

**Building:**

**Installer:**

**System/Unit Identifier:**

**Location:**

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Performance Testing Identification Form

01 91 23 - 1
## System/Unit Identifier:

### Step by Step Detailed Procedure

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SECTION 01 91 29
FUNCTIONAL PERFORMANCE TEST CERTIFICATION

Owner's Project #: 166/

Identification of Equipment or System: 

Location of Equipment or System: 

Manufacturer / Supplier: 

This date: 

Functional Performance Test Procedure No: 

Components Included: 

The above systems and components integral to this equipment are complete and have undergone Functional Performance Tests. All Functional Performance Test procedures are complete and have been checked off only by parties having direct knowledge of the event, as indicted below, respective to each responsible contractor. This Functional Performance Test is submitted for approval and is subject to the attached list of outstanding items not completed successfully. Contractor shall submit a Deficiency Form upon completion of any outstanding or deficient items. None of the outstanding items preclude safe and reliable functional tests being performed.

CHECK ONE: □ Deficiency listing attached; or, □ No Deficiencies Found.

All Designer and Contractor punch list items for this system and related equipment have been addressed and corrected prior to Functional Performance Testing.

The Functional Performance Test procedures were reviewed and approved by the installer and applicable subcontractors prior to testing.

CONTRACTOR'S CERTIFICATION OF PERFORMANCE:

I hereby certify that the above described equipment or system, has been energized, operated, adjusted, and balanced in accordance with requirements of the Contract Documents and the manufacturer's recommendations for a sufficient period to confirm that operation complies in all respects with the Contract Requirements.

Signature Print Name Date

Installer: ____________________________ ____________________________ 

General Contractor: ____________________________ ____________________________ 

Designer / Consultant: ____________________________ ____________________________ 

Functional Performance Test Certification
01 91 29 - 1
SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Demolition and removal of selected portions of building or structure.
   2. Demolition and removal of selected site elements.
   3. Salvage of existing items to be reused or recycled.

B. Related Requirements:
   1. Section 017300 "Execution" for cutting and patching procedures.
   2. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.
B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.


C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

D. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
1.7 CLOSEOUT SUBMITTALS
A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE
A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS
A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
   1. Before selective demolition, Owner will remove the following items:
      a. Loose furnishings owner wishes to keep /reuse.
C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
D. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
   1. Hazardous material remediation is specified elsewhere in the Contract Documents.
   2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
E. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches (300 mm) or more.
F. Storage or sale of removed items or materials on-site is not permitted.
G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.
1.10 WARRANTY
   A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:
      1. Existing membrane roof.
   B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.11 COORDINATION
   A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
   B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
   B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
   C. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
      1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
   D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
   E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

1. Comply with requirements specified in Section 013233 "Photographic Documentation."
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.
3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least 2 hours after flame-cutting operations.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Remove foundations of buildings and structures, floor slabs, structure remnants, drain pipes, and miscellaneous below grade structures should they exist or be encountered in the project area to a depth of not less than one foot below natural ground, except in the construction area where a depth of not less than two feet below sub-grade elevations is required.
11. Backfill excavations below planned grades resulting from demolition operations with compacted fine-grained fill or flowable fill (i.e. CLSM) Fill cavities left by structure removal within the prism of construction and below subgrade elevation to the level of the surrounding ground and compact in accordance with Section 31 20 00.
12. Reroute utilities as required and completely remove abandoned utilities.
13. Remove and replace or re-compact all subgrade soils disturbed, loosened and/or softened by demolition operations.

B. Dispose of demolished items and materials promptly.

C. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

D. Work in Historic Areas: Selective demolition may be performed only in areas of Project that are not designated as historic. In historic spaces, areas, and rooms, or on historic surfaces, the terms "demolish" or "remove" shall mean historic "removal" or "dismantling" as specified in Section 024296 "Historic Removal and Dismantling."

E. Removed and Salvaged Items:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area off-site designated by Owner.
   5. Protect items from damage during transport and storage.

F. Removed and Reinstalled Items:
   1. Clean and repair items to functional condition adequate for intended reuse.
   2. Pack or crate items after cleaning and repairing. Identify contents of containers.
   3. Protect items from damage during transport and storage.
   4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

G. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

E. Concrete Pavement: Remove concrete pavement, parking strip, base, curbs, gutters, sidewalks, driveways, etc., and dispose of as follows:
   1. Dispose of items below subgrade elevations by no more than two feet.
   2. Break items more than two feet below subgrade elevations into sizes not to exceed two feet in maximum dimension and leave in place unless it interferes with succeeding items of construction.
   3. Stockpile ballast, gravel, bituminous pavement or other pavement materials when required.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction and recycle or dispose of them.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
   3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.9 SELECTIVE DEMOLITION SCHEDULE

A. Remove: Areas indicated on drawings including designated deteriorated structure, elevator, existing doors and windows (except small windows indicated adjacent to south entry).

B. Remove and Salvage: Existing doors, hardware, and other items indicated by owner at preconstruction meeting. Existing roof tiles. Existing Granite Setts/Cobblestones.
C. Remove and Reinstall: Selected doors and frames as indicated on drawings.
D. Existing to Remain: Preserve contributing historic elements of building.

END OF SECTION 02 41 19
SECTION 02 42 96 - HISTORIC REMOVAL AND DISMANTLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section includes historic treatment procedures in the form of special types of selective demolition work for designated historic spaces, areas, rooms, and surfaces and the following specific work:

   1. Removal and dismantling of indicated portions of building or structure and debris hauling.
   2. Removal and dismantling of indicated site elements and debris hauling.
   3. Salvage of existing items to be reused or recycled.

   B. Related Requirements:

   1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.3 DEFINITIONS
   A. Dismantle: To disassemble or detach a historic item from a surface, or a nonhistoric item from a historic surface, using gentle methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

   B. Existing to Remain: Existing items that are not to be removed or dismantled, except to the degree indicated for performing required Work.

   C. Remove: To take down or detach a nonhistoric item located within a historic space, area, or room, using methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

   D. Retain: To keep existing items that are not to be removed or dismantled.

   E. Salvage: To protect removed or dismantled items and deliver them to Owner.

1.4 PRECONSTRUCTION MEETINGS
   A. Preconstruction Conference(s): Conduct conference(s) at Project site.

   1. Review minutes of Preliminary Historic Treatment Conference that pertain to removal and dismantling procedures and protection of historic areas and surfaces.
   2. Review list of items indicated to be salvaged.
3. Verify qualifications of personnel assigned to perform removal and dismantling.
4. Inspect and discuss condition of each construction type to be removed or dismantled.
5. Review requirements of other work that depends on condition of substrates exposed by removal and dismantling work.
6. Review methods and procedures related to removal and dismantling work, including, but not limited to, the following:
   a. Historic removal and dismantling specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
   b. Materials, material application, sequencing, tolerances, and required clearances.
   c. Fire prevention.
   d. Coordination with building occupants.

1.5 INFORMATIONAL SUBMITTALS

A. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by Contractor's removal and dismantling operations.

B. List of Items Indicated to Be Salvaged: Prepare a list of items indicated on Drawings to be salvaged for Owner's use or for reinstallation. Submit 15 days before preconstruction conference.

C. Inventory of Salvaged Items: After removal or dismantling work is complete, submit a list of items that have been salvaged.
   1. Include item description, item condition, number of items if more than one of a type, and tag number. Include photo of item in original location.
   2. As work proceeds, include on the inventory items that were indicated to be salvaged and items of historic importance discovered during the work. Document reasons, if any, why an item indicated to be salvaged was not salvaged.

1.6 QUALITY ASSURANCE

A. Removal and Dismantling Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for each phase of removal and dismantling work, including protection of surrounding and substrate materials and Project site.
   1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
   2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.

B. Mockups: Prepare mockups of specific historic removal and dismantling procedures specified in this Section to demonstrate aesthetic effects and to set quality standards for materials and execution.
   1. Typical Removal Work: Remove typical wall area and door/frame as shown on Drawings.
   2. Typical Dismantling Work: Dismantle typical fluorescent lighting fixture from ornamental plaster surface as shown on Drawings.
3. Typical Removal Work: Remove an approximately 50-sq. ft. (4.6-sq. m) area of typical wall
4. Typical Dismantling Work: Dismantle one door and frame indicated to be removed and reused.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

C. Regulatory Requirements: Comply with notification regulations of authorities having jurisdiction before beginning removal and dismantling work. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.7 FIELD CONDITIONS
A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.
C. Hazardous Materials: Hazardous materials are present in construction affected by removal and dismantling work. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
   1. Hazardous material remediation is specified elsewhere in the Contract Documents.
   2. Do not disturb hazardous materials or items suspected of containing hazardous materials, except under procedures specified elsewhere in the Contract Documents.
   3. If unanticipated asbestos is suspected, stop work in the area of potential hazard, shut off fans and other air handlers ventilating the area, and rope off area until the questionable material is identified. Reassign workers to continue work in unaffected areas. Resume work in the area of concern after safe working conditions are verified.
D. Storage or sale of removed or dismantled items on-site is not permitted unless otherwise indicated.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 HISTORIC REMOVAL AND DISMANTLING EQUIPMENT
A. Removal Equipment: Use only hand-held tools, except as follows or unless otherwise approved by Architect on a case-by-case basis:
   1. Light jackhammers are allowed subject to Architect's approval.
   2. Large air hammers are not permitted.
B. Dismantling Equipment: Use manual, hand-held tools, except as follows or otherwise approved by Architect on a case-by-case basis:
1. Hand-held power tools and cutting torches are permitted only as submitted in the historic treatment program. They must be adjustable so as to penetrate or cut only the thickness of material being removed.
2. Pry bars more than 18 inches (450 mm) long and hammers weighing more than 2 lb (0.9 kg) are not permitted for dismantling work.

3.2 EXAMINATION

A. Preparation for Removal and Dismantling: Examine construction to be removed or dismantled to determine best methods to safely and effectively perform removal and dismantling work. Examine adjacent work to determine what protective measures are necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed or dismantled and location of utilities and services to remain that may be hidden by construction that is to be removed or dismantled.

   1. Verify that affected utilities are disconnected and capped.
   2. Inventory and record the condition of items to be removed and dismantled for reinstallation or salvage. Enter this information on the submittal of inventory of salvaged items.
   3. Before removal or dismantling of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.
   4. Engineering Survey: Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures as a result of removal and dismantling work.

B. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs and preconstruction video recordings.

   1. Comply with requirements specified in Section 013233 "Photographic Documentation."

C. Perform surveys as the Work progresses to detect hazards resulting from historic removal and dismantling procedures.

3.3 HISTORIC REMOVAL AND DISMANTLING

A. General: Have removal and dismantling work performed by a qualified historic removal and dismantling specialist. Ensure that historic removal and dismantling specialist's field supervisors are present when removal and dismantling work begins and during its progress.

B. Perform work according to the historic treatment program and approved mockup(s).

   1. Perform removal and dismantling to the limits indicated.
   2. Provide supports or reinforcement for existing construction that becomes temporarily weakened by removal and dismantling work, until the Project Work is completed unless otherwise indicated.
   3. Perform cutting by hand or with small power tools wherever possible. Cut holes and slots neatly to size required, with minimum disturbance of adjacent work.
   4. Do not operate air compressors inside building unless approved by Architect in each case.
   5. Do not drill or cut columns, beams, joints, girders, structural slabs, or other structural supporting elements, without having Contractor's professional engineer's written approval for each location before such work is begun.
6. Dispose of removed and dismantled items off-site unless indicated to be salvaged or reinstalled.

C. Water-Mist Sprinkling: Use water-mist sprinkling and other wet methods to control dust only with adequate, approved procedures and equipment according to the historic treatment program to ensure that such water does not create a hazard or adversely affect other building areas or materials.

D. Unacceptable Equipment: Keep equipment that is not permitted for historic removal or dismantling work away from the vicinity where such work is being performed.

E. Removing and Dismantling Items on or Near Historic Surfaces:
   1. Use only dismantling equipment and procedures within 12 inches (300 mm) of historic surface. Do not use pry bars. Protect historic surface from contact with or damage by tools.
   2. Unfasten items in the opposite order from which they were installed.
   3. Support each item as it becomes loosened to prevent stress and damage to the historic surface.
   4. Dismantle anchorages.

F. Masonry Walls:
   1. Remove masonry carefully, and erect temporary bracing and supports as needed to prevent collapse of materials being removed.
   2. Dismantle top edge and sides before removing wall. Stop removal work and immediately inform Architect if any structural elements above or adjacent to the work show signs of distress or dislocation during any phase of removal work.
   3. Remove wall in easily managed pieces.
   4. During removal, maintain the stability of the partially remaining wall. Notify Architect of the condition of temporary bracing for wall if work is temporarily stopped during the wall's removal.

G. Steelwork:
   1. Expose structural steel for examination by Architect and Contractor's professional engineer before proceeding with removal or dismantling.
   2. If distress in structure is apparent during performance of the work, stop removal or dismantling and take immediate precautionary measures to ensure safety of the structure. Inform Architect of the problem, steps taken, and proposed corrective actions.
   3. Brace and support structural steel being removed and remaining during removal and dismantling.
   4. Concrete-Encased Steel: Where steel is known to be encased by concrete that is being removed, saw cut with blades that can cut no deeper than the thickness of the concrete cover, with an adequate margin for error in the location of the steel. Isolate sections of concrete by saw cutting before beginning removal.

H. Loose Plaster: Identify loose, nonhistoric plaster, and separate it from its substrate by tapping with a hammer and prying with a chisel or screwdriver. Do not use pry bars. Leave sound, firmly adhered plaster in place. Do not damage, remove, or dismantle historic plasterwork, except where indicated or where it is an immediate hazard to personnel and as approved by Architect.

I. Concrete Floor Surface Removal: Remove floor surfaces, fill, and topping to the indicated lower elevations or cleavage planes as indicated on Drawings. Use dismantling methods when removing floor surfaces 12 inches (300 mm) or less away from historic walls. Take away material to a uniform surface at the indicated level.
J. Anchorages:

1. Remove anchorages associated with removed items.
2. Dismantle anchorages associated with dismantled items.
3. In nonhistoric surfaces, patch holes created by anchorage removal or dismantling according to the requirements for new work.
4. In historic surfaces, patch or repair holes created by anchorage removal or dismantling according to Section that is specific to the historic surface being patched.

END OF SECTION 02 42 96
SECTION 02 82 33 – REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIALS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Furnishing and paying for all labor, services, materials, equipment, insurance, permits, transport, disposal, and decontamination facilities necessary to carry out the removal and disposal of asbestos-containing materials (ACM) from Building 60 (new IPER Center site) on the ETSU campus in Johnson City, Tennessee, prior to selective interior renovations. The ACM to be removed are listed below. Also indicated is whether the material is considered friable or non-friable for abatement and disposal purposes (see Subpart 1.04). The ACM locations and estimated quantities are provided in the August 20, 2015 “Environmental Survey Report” prepared by GEOServices, LLC (GEOS).

1. Building #60 (future IPER Center) - The 38,600-ft² building was originally constructed between 1904 and 1908. Multiple general and specific renovations have occurred since initial construction. The structure has four stories. The Basement is partially subgrade and covers the entire footprint of the structure. The original plumbing and mechanical connections enter at the Basement level. Floors 1 through 3 are above grade. A ladder on the 3rd Floor leads to a small penthouse at roof level which houses elevator equipment. Some areas of the building are used for storage but the majority of the spaces are empty. Confirmed and assumed ACM are:

   a. Coating on exterior roof vents and semi-circular dormer type windows – Confirmed, non-friable, exterior roof.
   b. Fire door interiors – tagged entry, room divider, and elevator doors with potential asbestos-containing interiors – Assumed, non-friable if removed intact.

B. The referenced report may be used to aid in bidding the project. Renovation activities may reveal materials other than those identified. Such materials shall be included in the Work of the Contract. If other suspect materials are discovered, they should be assumed to be ACM until additional sampling can be conducted. The asbestos abatement Contractor shall be responsible for confirming and abating the ACMs presented in the August 20, 2015 “Environmental Survey Report” prepared by GEOS. The Owner and its representatives will only be held responsible for additional work (i.e., items not included in the report or not readily discoverable prior to destructive testing) if brought to the Owner's attention prior to removal or abatement.

1.02 COORDINATION

A. The Contractor shall ensure that the asbestos removal work described within this section is completed prior to the performance of any other work of this contract that will disturb or potentially disturb asbestos-containing or contaminated materials.

1.03 DEFINITIONS

ACM Asbestos-Containing Material

Adequately Wet A term defined in 40 CFR 61, Subpart M and EPA 340/1-90-019 that means to sufficiently mix or penetrate with liquid to prevent the release of particulate. If visible emissions are observed coming from ACM, then that material has not been adequately wetted;
however, the absence of visible emissions is not sufficient evidence of being adequately wetted.

Amended Water  Water Treated with a Wetting Agent

Building  Building 60 (new IPER Center site) on the ETSU campus

Category I  A term as defined in 40 CFR 61, Subpart M and EPA 340/1-90-018 that means Non-Friable ACM asbestos-containing packing, gaskets, resilient floor covering, and asphalt roofing products containing more than 1 percent asbestos as determined using the method specified in 40 CFR 763, Appendix A, Subpart F, Section 1, Polarized Light Microscopy

Category II  A term as defined in 40 CFR 61, Subpart M and EPA 340/1-90-018 that means any non-friable materials other than Category I non-friable materials

Contractor  Asbestos Abatement Contractor

Controlled Areas  Areas that are restricted to persons directly associated with the Work of this section. These areas are identified by signs and/or opaque polyethylene barriers (if applicable).

Critical Barrier  A double layer sheet of polyethylene (6-mil minimum) used to separate the controlled area from other portions of the building and outside of the building.

Abatement Designer and Owner’s Environmental Consultant

Quantum Environmental and Engineering Services, LLC 126 Dante Road Knoxville, Tennessee 37918 (865) 689-1395

EL  Excursion Limit. The OSHA 30-min. allowable exposure of 1.0 fiber/cc of air

EPA  United States Environmental Protection Agency

Friable ACMs  A term as defined in 40 CFR 61, Subpart M and EPA 340/1-90-018 that means any material containing more than 1 percent asbestos, that when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

HEPA  High Efficiency Particulate Air (99.97 percent minimum efficiency)

Micron  One millionth of a meter, or 3.937 X 10^{-5} inches

NIOSH  National Institute for Occupational Safety and Health

NPE  Negative Pressure Enclosure

OSHA  Occupational Safety and Health Administration
PEL  
Permissible Exposure Limit. The OSHA, 8-hour time weighted average (TWA) allowable exposure. For asbestos exposure, the PEL is 0.1 fibers per cubic centimeter (f/cc) of air.

Standard For Air Clearance  
0.01 fibers per cubic centimeter of air (f/cc) under an aggressive environment for interior samples and under a non-aggressive environment for exterior samples. The interior samples will be collected using stationary pumps. The exterior samples will be collected using personnel air pumps placed on asbestos removal workers. Clearance standards may be adjusted based on the results of background testing conducted prior to abatement activities.

Time-Weighted Average (TWA)  
TWA is an 8-hour time weighted average of airborne concentration of fibers (longer than 5 microns) per cubic centimeter of air which represents the employee’s 8-hour workday, as determined by 29 CFR 1926.1101, Appendix A.

1.04 DISPOSAL SITES
A. The ACM and associated debris must be disposed at an asbestos approved sanitary landfill for the friable materials, and at either an asbestos approved sanitary landfill or at a landfill that has been properly notified and can accept non-friable ACM and associated debris for the non-friable materials. The Contractor selected for the work must make appropriate arrangements for disposal based on the notification requirements listed in Subpart 1.07. The Contractor must also submit documentation stating the location of the disposed ACM in the landfill (degrees and minutes or sketch).

1.05 QUALITY ASSURANCE
A. All asbestos removal and related Work shall be accomplished by a Contractor (or subcontractor) specializing in, and having a record of, not less than two years successful experience in asbestos removal and related Work. The Contractor’s superintendent shall have not less than one year of full-time experience in responsible charge of asbestos removal operations within the 24-month period preceding the start of this project. The training of the superintendent shall be in compliance with current EPA and State of Tennessee regulations. The Contractor, supervisors, and workers shall be accredited and licensed in Tennessee, as is required under Tennessee Rule 1200-1-20, Asbestos Accreditation Requirements.

1.06 REGULATORY REQUIREMENTS
A. All Work shall be in strict compliance with the current issues of federal, State and local regulations, codes and standards as listed below:
1. EPA Standards for Asbestos - 40 CFR 61, Sub-Part M
2. EPA National Emissions Standards for Hazardous Air Pollutants (NESHAPS)
3. OSHA Asbestos Standards - 29 CFR 1926.1101
5. OSHA Respiratory Protection Standards - 29 CFR 1910.134
6. Section 6, Toxic Substance Control Act (TSCA)
7. OSHA Construction Standards - 29 CFR 1926
11. U.S. Department of Transportation (DOT), including, but not limited to Hazardous Substances - 49 CFR 171 and 172
12. All attachments, memorandums and information sheets submitted by federal, State and local agencies
13. All State, county, and city codes and ordinances as applicable. Provide one copy of EPA, OSHA, State, and city regulations governing the work available for review at the Site.
14. Any applicable revisions, updates, or replacements to the items listed in 1.06.A.1 through 13.

1.07 SUBMITTALS

A. Pre-Job Submittals. Pre-Job Submittals shall be provided as required in Section 01 33 43, Subpart 1.04.

B. Post-Job Submittals. Post-Job Submittals shall be provided as required in Section 01 33 43, Subpart 1.06.

1.08 GENERAL PROTECTION OF PERSONS

A. Prior to commencement of Work, all workers shall be instructed and shall be knowledgeable in appropriate procedures of personnel protection during asbestos removal.

B. All workers entering Confined Spaces must be properly trained and certified for such work in accordance with OSHA Standard 1910.146. Work shall also be conducted in accordance with the Standard.

C. Contractor shall be solely responsible for enforcing worker protection requirements.

D. Contractor shall provide workers with personally issued and marked respiratory equipment approved by NIOSH and meeting specifications of OSHA. This respiratory equipment shall be suitable for the asbestos exposure level in the controlled area according to OSHA Standard 29 CFR 1926.1101 as identified by the Owner’s Environmental Consultant and/or as more stringently specified otherwise in these specifications. Provide disposable HEPA filters as required, with sufficient filters for replacement.

E. Contractor shall provide workers, Owner’s Environmental Consultant, and authorized visitors with sets of protective disposable clothing, head covers, gloves, eye protection and foot covers of sizes to properly fit individual workers and visitors whenever they are required to enter the controlled area. Provide a minimum of four sets per day for visitors and sufficient sets as required for workers and Owner’s Environmental Consultant. Contractor shall not be required to certify that visitors entering the Work Area be capable of wearing respirators or provide respirators for other than his own staff. Do not permit any person to enter the Work Area without the appropriate protective clothing and equipment.

F. Reporting Unusual Events: When an event of unusual and significant nature occurs at the site, prepare and submit a special report listing chain of events, persons participating, response and similar pertinent information. When such events are known or predictable in advance, advise Owner’s Environmental Consultant in advance, at earliest possible date.
G. Reporting Accidents: Prepare and submit reports of significant accidents, at site and anywhere else Work is in progress. For this purpose, a significant accident is defined to include events where personal injury is sustained, or property loss of substance is sustained.

H. Post telephone numbers and locations of emergency services including, but not limited to, fire, ambulance and police at the entrance to the decontamination unit.

.09 SIGN IN/OUT LOG

A. Contractor shall maintain a Sign-In/Sign-Out Log in the immediate vicinity of the change room of any decontamination area. Log shall be maintained from the time the first activity is performed involving the disturbance of ACM until acceptance of the final air test results. All persons entering the controlled area, including the Contractor's workers, Owner's Environmental Consultants, Owner and Government Officials shall be required to sign in and out each time upon entering and leaving the controlled area. All persons shall indicate name, time, company or agency represented and reason for entering the controlled area.

B. Except for Governmental Inspectors having jurisdiction, no visitors shall be allowed in any controlled area, except as authorized by the Owner or his representative.

1.10 SAFETY AND PROTECTION, OSHA COMPLIANCE

A. The Contractor warrants that he is familiar with the codes and requirements applicable to asbestos removal and/or disturbance Work and shall give all notices and comply with all laws, ordinances, rules and regulations applicable to the Work. If the Contractor observes that the Specifications or Plans are at variance therewith, he shall give written notice to the Owner's Environmental Consultant describing such variance. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without written notice to the Owner's Environmental Consultant, he shall bear all costs arising therefrom. The Contractor's particular attention is directed to the "Safety and Health Regulations for Construction" and subsequent amendments promulgated by the Department of Labor identified as Chapter XVII of 29 CFR 1926 and the necessity of complying with the regulations in the progress of his Work. Failure or omission on the part of the Owner, Owner's Environmental Consultant or any of their representatives either to discover or to bring to the attention of the Contractor shall not be used as defense for failure on his part to fulfill such requirements.

1.11 SPECIFIC PROTECTION OF WORKERS

A. Respirators shall be selected and used in accordance with manufacturers’ recommendations, and shall be approved by NIOSH for use in environments containing airborne asbestos fibers. Personnel who handle ACM, enter asbestos regulated controlled area that require the wearing of a respirator, or who are otherwise carrying out abatement activities that require the wearing of a respirator, shall be provided with approved respirators that are fully protective of the worker at the measured or anticipated airborne asbestos concentration level to be encountered. Respiratory protection shall comply with the 29 CFR 1926, and 29 CFR 1910.

B. All Work in Permit-required Confined Spaces shall comply with 29 CFR 1910.146.

C. In All Removal Areas
1. Workers shall always wear a respirator properly fitted on the face while in the removal areas. Workers wearing tight-fitting face pieces shall be clean-shaven to the extent that the hair does not interfere with the sealing surface of the respirator. This must be documented by a standard respirator fit test.

2. The Contractor shall instruct and train workers in proper respirator use.

3. Workers shall wear disposable, full-body coveralls and disposable head covers and footwear suitable for asbestos work in the removal areas.

4. Workers shall not eat, drink, smoke, chew gum, tobacco, or apply cosmetics in the removal areas.

5. The Contractor shall provide disposable coveralls, head cover, and footwear to any official representative of the Owner or Owner’s Environmental Consultant who inspects the project.

6. All persons entering the removal areas shall wear an approved respirator and disposable coveralls, head cover and footwear. Contractor shall not be required to certify that visitors entering the Work Area be capable of wearing respirators.

7. The Contractor shall instruct and train workers in the nature of asbestos and the hazards related to asbestos exposure during removal and/or disturbance work.

8. For areas where ACMs are not removed intact/encapsulated, the Contractor shall set up a decontamination unit consisting of a change room, shower, and equipment room, enclosed and separated by triple-flap polyethylene air locks, connected to the controlled areas. All workers, without exception, shall:
   a. Remove and properly store street clothes in the change room and put on new disposable coveralls, head covers, footwear and cleaned respirators before entering the controlled area.
   b. Upon leaving the controlled area, remove the disposable coveralls, head covers and footwear in the equipment room and dispose of them in an appropriate waste container. Still wearing their respirators, workers shall proceed to the shower and remove their respirators while showering with soap and tempered water. Wetted HEPA respirator cartridges shall be disposed in appropriate containers.
   c. This procedure shall be followed each time a worker enters or leaves the controlled area.

PART 2 - PRODUCTS

2.01 MATERIALS

A. 4-mil and 6-mil fire-retardant polyethylene sheets in sizes to minimize the frequency of joints.

B. Tape: Glass fiber or other type capable of sealing joints of adjacent plastic sheets and for attachment of plastic sheet to finished or unfinished surfaces of dissimilar materials under both dry and wet conditions.

C. Surfactant (Wetting Agent) and Sealants: Shall consist of materials which are non-toxic and non-irritating to skin and eyes, and non carcinogenic.

D. Impermeable Containers: Air and water-tight, suitable to receive and retain any asbestos-containing or contaminated materials until disposal at an approved site, and labeled in accordance with OSHA regulations 29 CFR 1910.1001, 29 CFR 1926.1101, and 29 CFR 1910.145; EPA regulation 40 CFR Part 61; and DOT regulations 49 CFR 172, 173, 178, and 179. Three types of impermeable containers may be used:
   1. 6-mil plastic bags sized to fit within the drum
   2. Metal or fiber drums with tightly fitting lids
3. 6-mil polyethylene sheets

E. Warning Labels and Signs: In conformance with 29 CFR 1926.1101 (asbestos), 49 CFR 171 and 172, and 40 CFR 61, Sub-Part M.

F. Other Materials: Provide all other materials, such as lumber, nails, and hardware, which may be required to construct and dismantle the decontamination area and the barriers that isolate the controlled area.

G. HEPA Vacuums: For pre-cleaning or cleaning residual dust at the area of removal.

H. Scaffolding and ladders: Provide all scaffolding, ladders and/or staging, etc., as necessary to accomplish the Work of this contract. Scaffolding may be suspension type; or standing type such as metal tube and coupler, tubular welded frame, pole or outrigger type; or cantilever type. The type, erection and use of all scaffolding shall comply with all applicable OSHA provisions. No metal ladders shall be used in wet areas.

PART 3 - EXECUTION

3.01 CONTROLLED AREA CATEGORIES

A. The following categories of Controlled Areas may exist during the execution of this contract. Category 1 has not been confirmed onsite. The categories and the asbestos-containing materials that may be removed under each category are as follows.

1. Limited Containment
   a. TSI and fittings (glove bag removal)

2. Non-Containment
   a. Roof vent and dormer coatings
   b. Assumed ACM fire doors removed intact

3.02 CONTROLLED AREA PREPARATION (MINIMUM REQUIREMENTS)

A. In Controlled Areas described in 3.01.A.1-2, the Contractor shall:

1. Ensure that all ventilating systems or any other system bringing air into or out of the controlled areas is disabled. Disable systems by disconnecting wires, removing circuit breakers, lockable switches or other positive means that will prevent accidental restarting of equipment.

2. Lockout power to circuits running through the controlled areas by switching off all breakers or removing fuses serving these circuits. Label breakers with tape over breaker with notation, "DANGER circuits being worked on." Lock panel and have all keys under control of Contractor's superintendent. If circuits cannot be shut down for any reason, label at intervals 4 feet, 0 inches on center with tags reading, "DANGER live electric circuit. Electrocution Hazard". Label circuits that are in hidden locations but which may be affected by the Work in a similar manner.

3. Isolate the controlled areas to prevent entry by unauthorized personnel into the area by placing opaque polyethylene barriers at each entrance to the area and by providing warning signs in appropriate languages at each locked door leading into the controlled area. The signs shall be 1'-2" X 1'-8" in dimension, and (after June 1, 2016) shall read as follows:

   DANGER
4. Construct any and all necessary temporary walls to completely isolate areas of asbestos disturbance.
5. If ACMs are disturbed, seal all openings (doors, windows, etc.) with a 6-mil (minimum) polyethylene containment barrier to prevent leakage of air into the outside environment or other portions of the building.
6. The Contractor shall establish emergency exits and procedures for the controlled areas, satisfactory to fire officials.
7. Do not cover stairs or ramps with unsecured sheet plastic. Where stairs or ramps are covered with plastic, provide 3/4-inch exterior grade plywood treads securely held in place, over plastic. Do not cover rungs or rails with any type of protective materials.
8. Provide sufficient HEPA air filtration units to maintain airflow of at least four complete air changes per hour in the disturbance/removal areas.
9. Ensure that barriers and plastic enclosures remain effectively sealed and taped. Inadvertent tears in plastic shall be repaired with fiber tape and the tear covered by plastic applied with spray adhesive, overlapping the tear by six inches on all sides.
10. The Contractor shall set up a decontamination facility connected to the controlled area as indicated in subparagraph 1.11.C.8. Water from the shower shall be filtered with an acceptable asbestos filtering system adequate to meet local sanitary sewer discharge standards prior to discharge to the sewer.
11. Use scaffolding and/or ladders where necessary to access work surfaces. Scaffold construction and use shall comply with 29 CFR 1926, Subpart L.

B. In the Limited Containment Controlled Areas (mini-enclosure), the Contractor shall (Minimum Requirements):
1. Complete all required activities identified in Subparagraph 3.02.A, with the exception of Subparagraph 3.02.A.5 – Critical Barriers. In accordance with the OSHA Construction Industry Asbestos Standard (29 CFR 1926.1101), perimeter area air monitoring and perimeter area surveillance may be utilized as an alternative to critical barriers and full containment.
2. Floor and horizontal surface covering: Impermeable dropcloths shall be placed on surfaces beneath all removal activity.
3. Decontamination Unit: As required by OSHA 1926.1101(j), for all Class I asbestos jobs involving over 25 linear feet of TSI, comply with all required activities.
4. Continuous negative pressure requirement: All glovebag/mini-enclosure activities shall be conducted under continuous negative pressure demonstrated by testing prior to ACM disturbance and using attached HEPA vacuum systems to the bag to prevent collapse during removal.

C. In Non-Containment Controlled Areas, the Contractor shall (Minimum Requirements):
1. Cordon the controlled area to prevent entry by unauthorized personnel by placing warning tape around area of ACM removal. The tape shall be no closer than 20 feet from the immediate area.
of removal. The Contractor shall also provide warning signs at each access to the controlled areas in appropriate languages. Signage shall be in accordance with subparagraph 3.02.A.3.

2. Close, secure and seal for duration of work all wall openings, windows, doors, and penetrations in controlled area, sanitary stack vents, etc.

3. Ascertain that the mechanical units that have exterior intake or exhaust vents within the area of removal are shut down.

4. All elevated work shall be performed in compliance with 29 CFR 1926 Subpart M, Fall Protection.

3.03 ACM REMOVAL

Note: The following are the minimum requirements for asbestos removal. These requirements in no way relieve the Contractor of the responsibility for their own methods of removal.

A. In Limited Containment Areas, the Contractor shall (Minimum Requirements):

1. Construct and maintain the mini-enclosure in accordance with 29 CFR 1926.1101, Appendix G. Mini-enclosure design plan and construction must be reviewed by the Owner’s Environmental Consultant prior to use.

2. Inside the mini-enclosure, thoroughly wet ACM prior to removal to reduce fiber dispersal into the air. Accomplish wetting by using a fine spray (mist) of amended water or removal encapsulant. Mist the area sufficiently to wet the material without causing excessive dripping or breaking. Allow time for water or removal encapsulant to penetrate material thoroughly.

3. If amended water is used, spray material repeatedly during the work process to maintain a continuously wet condition. If a removal encapsulant is used, apply in strict accordance with manufacturer’s written instructions.

4. Mist the entire enclosure during removal procedures with amended water to reduce airborne fiber levels.

5. Remove wetted ACM in small sections. As it is removed, simultaneously pack material into 6-mil disposal bags or poly sheeting. Twist neck of bags, bend over (goose neck) and seal with minimum three wraps of duct tape.

6. Evacuate air from disposal bags with HEPA filtered vacuum cleaner before sealing.

7. Contractor personnel shall adhere to the following minimum glovebag removal procedure requirements:

   a. At least two persons shall perform glovebag operations.
   b. Before beginning Work, the glovebag/mini-enclosure shall be inspected for leaks and smoke tested to ensure integrity.
   c. Glovebags or other polyethylene plastic enclosures shall not be used on surfaces whose temperature exceeds 150 degrees.
   d. Cut open the side ports to allow entry of water supply and HEPA vacuum hose and seal airtight. Finish sealing entire bag to pipe thoroughly with tape.
   e. Remove all insulation from the pipe and/or fitting contained within the bag without disturbing the bag-to-pipe seal. Care must be taken to minimize dust generation by keeping the insulation wet with amended water.
   f. Wipe the exposed piping with a scouring pad equivalent to remove any residual ACM.
   g. All removal tools shall be held in the gloves which can then be pulled outward from the bag. Tape shall be used to constrict the sleeve and create a bag for the tools made from the glove.
h. Cut the glove from the bag through the center of the tape, leaving the glove and sleeve sealed to prevent fiber escape. The tool pouch will be ready for insertion into the next glovebag or into a container of water at day’s end.

i. Evacuate the bag of nearly all air with the suction from the HEPA vacuum while avoiding intake of water into the vacuum hose.

k. Gather the bag into a tight bundle beneath the attachment point to the pipe and hold together with fiber tape. Carefully disconnect the bag from the pipe.

l. Place used glovebags into approved asbestos disposal containers.

m. HEPA vacuum the controlled area to remove any residual fibers.

8. Wrapping Procedures. Because any piping in the building will not be used in future configurations, the Contractor may choose to wrap materials or cut out piping with cutting tools. The Contractor shall adhere to the following minimum wrapping and cutting procedures:

a. Ascertain that the pipe lines have been shut down and the lines have been drained.

b. Remove sections of insulation with glovebag procedures, spaced to manageably remove and dispose of the systems. Glovebag procedures must be in conformance with subparagraph 3.03.A.7. Tape the ends of the pipe to minimize fiber emissions.

c. Wrap the materials with two layers of 6-mil polyethylene and tape ends.

d. Cut the piping with either a saw or torch. If acetylene is used proper respiratory protection must be worn.

e. Decontaminate the wrapped materials with amended water and HEPA vacuums and remove from controlled area.

B. In Non-Containment removal areas are required, the Contractor shall:

1. Spray the ACM with a fine mist of amended water.

2. Carefully remove the asbestos-containing materials by use of hand tools. Hand cutting of the material will be the only acceptable method. Pry bars, axes, adzes, shovels, ice chippers may be used.

3. Mist the immediate area of removal with amended water before and during the removal procedures. Maintain wet condition of the ACM, but do not use excessive amounts of water.

4. Provide HEPA vacuum for immediate clean-up of amended water and debris.

5. Neatly place the materials in either two (2) approved disposal bags or two (2) independent layers of 6-mil polyethylene. Do not allow material to dry.

6. Use duct or masking tape to make an airtight seal around the end of the bag or seams of the polyethylene wrap.

7. Place appropriate warning labels on double-bagged or wrapped materials.

8. Carefully place the ACM in the disposal unit. The disposal unit should be a closeable dumpster or truck.

9. In accordance with NESHAP, asphalt-based roofing materials do not require abatement prior to demolition, but access to the ACM should be limited and the materials must be segregated for proper disposal.

3.04 INSPECTION AND CLEAN-UP FOR CONTROLLED AREAS

A. The ACM debris shall be sealed in plastic bags or shall be wrapped in a minimum of two (2) polyethylene sheets (6-mil minimum). Initial bagging of waste shall be supplemented by a secondary containment, either by use of a second bag (6-mil minimum) or by use of a fiber or metal drum. If it appears likely that the waste material will tear the plastic, the bag must be placed into a drum for disposal. Bags and drums shall be marked with the OSHA label prescribed by the OSHA Regulations...
referenced in this section. The outside of all containers shall be cleaned before leaving the controlled area.

B. After ACM removal procedures have been completed, the Abatement Contractor shall notify the Owner's Environmental Consultant and Owner's Project Monitor. The Owner's Project Monitor shall visually observe the areas. The Abatement Contractor's on-site abatement supervisor responsible for the Work shall accompany the Project Monitor during the inspection, and make note of any problems such as incomplete removal Work, additional cleaning required, removal of visible dust/debris, etc. The Abatement Contractor shall make every effort to immediately resolve problems so that the visual site inspection can be completed satisfactorily at that time. If dust or debris is found during the inspection, the abatement subcontractor shall re-clean the Work Area and the visual site inspection will be repeated. Re-cleaning of the Work Area shall be completed by the Abatement Contractor at no additional cost.

C. Upon completion of the observation and subsequent approval, Owner's Project Monitor will perform final clearance air sampling, if applicable. In areas which include only non-friable or glovebag abatement activities, the Owner may elect to use area and/or personnel monitoring data in lieu of a clearance sampling event. Upon successful completion of the final clearance air sampling, or acceptance of other monitoring data, the Abatement Contractor shall remove the decontamination enclosure systems. The remaining barriers between contaminated and clean areas and all seals on openings into the Controlled Area shall be removed and disposed as contaminated waste.

D. All plastic sheeting tape, cleaning material, clothing, and all other disposable material used in the asbestos removal operation or items used in the controlled area shall be packed into sealable plastic bags (6-mil minimum). These bags must be marked with the OSHA label prescribed by the OSHA Regulations.

3.05 FIELD QUALITY CONTROL

A. The Contractor shall conduct background, personnel, and area air monitoring (as needed). The Contractor's testing process must be approved by the Owner's Environmental Consultant prior to implementation. Test results shall be reported in terms of f/cc and collected in accordance with EPA, OSHA, and NIOSH-recommended sampling volumes for appropriate detection limits. All air sample analysis must be in accordance with the most current applicable version of NIOSH, the OSHA Reference Method Asbestos Standard for General Industry, 29 CFR 1910.1001 Appendix A, or other approved EPA methodology. All results must be posted at the job site and provided to the Owner's Environmental Consultant no later than 24 hours from sample collection.

Note: All locations of air tests are subject to review and change by the Owner's Environmental Consultant.

1. Background air monitoring may be conducted in order to provide data indicating background conditions in specific areas subject to and preceding ACM disturbance. If collected, background air samples shall be conducted according to the following:
   a. Two (2) minimum per full containment regulated area
   b. Minimum of 1 sample taken from all other proposed regulated areas
   c. Blanks - 10% of total, with a minimum of two (2)

2. Personnel air monitoring and associated laboratory analysis shall be conducted as required.
by OSHA regulations and any other codes or standards required for the protection of his
workers, or other purposes. OSHA personal air samples shall be conducted according to the
following:
   a. 25% of workers per Work shift minimum (all regulated areas)
   b. At least one sample per task per shift
   c. Blanks - 10% of total, with a minimum of two (2)

3. Area air monitoring shall be conducted at any regulated areas utilizing negative pressureenclosures to verify the effectiveness of work methods and engineering controls.
   a. At no time during interior ACM removal and/or disturbance shall area air monitoring
   results exceed regulatory standards. Operations shall be discontinued immediately and
Owner's Environmental Consultant and Owner Representatives shall be contacted if
visible emissions are observed emanating from the regulated area, or if airborne fiber
concentrations exceed the OSHA permissible exposure limit of 0.1 f/cc. The Contractor
shall immediately perform whatever action is necessary to reduce fiber concentrations to
accepted levels, and additional samples shall be collected in other adjacent areas as
determined to be necessary by the Owner's Environmental Consultant.
   b. The Contractor shall be technically and financially responsible for any asbestos fiber
contamination of adjoining areas and/or properties which occurs as a result of failures
to comply with Specifications during the asbestos activities. All equipment and/or
materials within these areas and/or properties shall be totally decontaminated or
disposed by the Contractor. If those items are designated by the Owner as items to
be preserved prior to demolition, then they shall be decontaminated, or replaced by
the Contractor with equipment and/or materials of equal or higher quality.
   c. Outside regulated area samples should be located as necessary to provide complete
data surrounding the regulated area (e.g., clean room of decontamination unit, HEPA
filtration exhaust, outside of critical barriers, etc.), in order to demonstrate the integrity
of containment and the effectiveness of Work methods and engineering controls. Outside
abatement work area (if conducted) air samples shall be conducted according to the
following:
      (1) Three (3) minimum per full or partial containment regulated area per Work shift
      (2) Two (2) minimum per limited or no containment regulated area per Work shift
      (3) One (1) minimum outside clean room/decontamination area per regulated area
      (4) One (1) minimum at HEPA filtration exhaust
      (5) Blanks - 10% of total, with a minimum of two (2)

4. Perimeter area surveillance and perimeter area air monitoring shall be performed in regulated
areas where mini-enclosure removal occurs without full containment NPE systems. Perimeter
area surveillance and perimeter area air monitoring will also be conducted in all regulated areas
were no means of containment is utilized. Perimeter air monitoring that spans the entire period
of asbestos removal activities can be used as “working final clearance samples” for exterior
Work.
   a. Operations shall be discontinued immediately and Owner's Environmental Consultant
and Owner representatives shall be contacted if visible emissions are observed emanating from the regulated area, or if airborne fiber concentrations exceed the OSHA
permissible exposure limit of 0.1 f/cc. The Contractor shall immediately perform
whatever action is necessary to reduce fiber concentrations to accepted levels, and
additional samples shall be collected in other adjacent areas as determined to be
necessary by the Owner's Environmental Consultant.
   b. The Contractor shall be technically and financially responsible for any asbestos fiber
contamination of adjoining areas and/or properties which occurs as a result of failures to comply with specifications during the asbestos activities. All equipment and/or materials within these areas and/or properties shall be totally decontaminated or disposed by the Contractor. If those items are designated by the Owner as items to be preserved prior to demolition, then they shall be decontaminated, or replaced by the Contractor with equipment and/or materials of equal or higher quality.

c. Perimeter air samples shall be conducted according to the following:
   (1) Sampling shall span the entire time period of asbestos removal activities
   (2) Samples shall be collected for each Work shift from the perimeter of regulated areas
   (3) One (1) minimum per round for every regulated area of disturbance of less than 160 square feet, 260 linear feet, or 35 cubic feet
   (4) Three (3) minimum per round for every regulated area of disturbance of more than 160 square feet, 260 linear feet, or 35 cubic feet
   (5) One (1) minimum at decontamination area per regulated area
   (6) Blanks - 10% of total, with a minimum of two (2).
3.06 FINAL CLEARANCE AIR MONITORING

A. The Owner will provide a certified Project Monitor and qualified Testing Laboratory to perform any final clearance testing of Work performed under Contract Documents to determine general compliance as described in Section 01 43 28.

B. Owner's Project Monitor and Testing Laboratory will perform any final clearance testing necessary to determine general compliance with Contract Documents, and observe and document on a regular basis the execution and progress of the Work. Such observation and documentation shall be for the sole benefit of the Owner and shall not be construed in any way as to include responsibility for Abatement Contractor's means, methods, techniques, sequences, or procedures involved with execution of the Work, nor shall such observation and documentation by Project Monitor and Testing Laboratory be construed to include responsibility for any safety programs or procedures either utilized or not utilized by Abatement Contractor during work.

C. Provision of Project Monitor and Testing Laboratory by Owner to perform testing for Owner shall not relieve Abatement Contractor from providing its own testing for compliance with specifications.

END OF SECTION 02 82 33
SECTION 02 83 19.13 – LEAD BASED PAINT REMOVAL AND DISPOSAL

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnishing of all labor, services, appliances, materials, equipment, insurance, and permits necessary to meet regulatory compliance and disposal requirements, and to control or otherwise protect workers from airborne concentrations of lead from surfaces during the removal and/or stabilization of lead-based paint (LBP) and lead-containing paint from surfaces at the ETSU IPER Center, Building 60 during building renovation. LBP is defined as painted or coated surfaces where lead concentrations are $\geq 1.0 \text{ mg/cm}^2$ (using XRF analysis) or 0.5% by weight. Lead-containing paint is defined as painted, coated, or varnished surfaces where lead concentrations are 0.009% or greater by weight.

B. Information is available to assist in determining the locations and concentrations of lead in painted surfaces in the August 20, 2015 “Environmental Survey Report” prepared by GEOServices, LLC (GEOS). Contractor shall be responsible for verifying actual current site conditions and evaluating conditions of painted surfaces by performing a thorough site inspection prior to removal and/or rehabilitation activities. The Owner and its representatives will not be held responsible for additional work caused by Contractor’s not performing a thorough site inspection.

C. The previous survey work indicates that LBP (deteriorated LBP and LBP adhered to building components) occurs on some materials identified for rehabilitation activities during this project. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), and Tennessee OSHA (TOSHA) regulations for worker safety apply to activities where workers may be exposed to lead. Precautions shall be taken, including but not limited to the adherence to the requirements of Subpart 3.02 of this Section, to ensure that workers, visitors, and other occupants are not exposed to lead dust during the Work.

1.02 RELATED WORK

A. Section 00 31 26: Hazardous Materials Data

B. Section 01 31 93: Administrative Logs

C. Section 01 33 43: Abatement Submittals

1.03 REGULATING AGENCIES

A. Two primary sets of regulations and regulating agencies apply for LBP and/or lead-containing paint in regard to the project:
   1. OSHA and TOSHA regulations for worker safety.
   2. TDEC Division of Solid and Hazardous Waste Management (DSHWM) regulations regarding disposal of LBP debris.

1.04 SCOPE OF WORK

A. Scope of Work: The scope of work for LBP removal shall include:
1. Removal of paint from building components as directed by Design Documents, where paint has peeled, alligatored, blistered, or crazed, to first sound paint layer. The locations are indicated in Specification Drawings.
2. If the coating has been confirmed as LBP, then containment of LBP chips and LBP debris.
3. Determination for hazardous lead concentrations using laboratory analysis by the Toxicity Characteristic Leaching Procedure (TCLP) for lead, based upon representative composite samples of any LBP chips and debris.
4. Disposal of LBP chips/disturbed LBP debris as either non-hazardous or hazardous waste depending on TCLP results.
5. Any painted demolition debris (materials not specified to remain) with intact coatings can be disposed of as ordinary construction waste without paint removal.

B. Contractor acknowledges that all details and specifics regarding the paint removal work are not necessarily shown or specified. Contractor shall visit the site and become familiar with the existing quantities, layers, condition of materials to be removed, and local conditions prior to commencement of work. Lack of knowledge relative to these conditions will in no way relieve Contractor of the obligation and responsibilities assumed under the contract. Contractor will be expected to provide all of the items, necessary and/or incidental, to complete the work consistent with this specification.

C. Asbestos-containing materials shall be abated according to Specification Section 02 82 33 prior to any paint removal work which could impact the asbestos-containing materials.

1.05 COORDINATION
A. Contractor shall ensure that painted surfaces are properly managed to control airborne concentrations of lead during the removal process.
B. Contractor shall coordinate paint removal phases with other project activities to ensure that containment is functioning properly and protecting workers from exposure in the other areas.

1.06 DEFINITIONS

AL  Action Level. Action level means employee exposure, without regard to the use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air (30 μg/m³) calculated as an 8-hour time-weighted average (TWA). The AL is an exposure level established by OSHA/TOSHA.

Building  The ETSU IPER Center, a.k.a. Building 60, Johnson City, Tennessee.

Competent Person  One who is capable of identifying existing and predictable lead hazards in the surroundings or working conditions and who has authorization to take prompt corrective measures to eliminate the hazards.

Controlled Areas  Areas that are restricted to persons directly associated with the work. Signs and restrictive tape identify these areas. Controlled areas will be areas where lead-containing paint removal is being performed.

Control of LBP  Lead-based and lead-containing paint must be controlled to the extent that the
Contractor is in compliance with federal, state and local regulations regarding worker and environmental impact.

**EPA**
United States Environmental Protection Agency

**LBP**
Lead-Based Paint

**OSHA**
Occupational Safety and Health Administration

**PEL**
Permissible Exposure Limit. An 8-hour time weighted average (TWA) exposure limit established by OSHA. The PEL-TWA for lead is 50 micrograms per cubic meter (µg/m³). Contractor shall ensure that no employee is exposed to lead at concentrations greater than 50 µg/m³ averaged over an 8-hour period, or if exposure exceeds the PEL the employees’ allowable exposure must be reduced according to the formula in 29 CFR 1926.62 (c)(2).

**TCLP**
Toxicity Characteristic Leaching Procedure

**TOSHA**
Tennessee Occupational Safety and Health Administration

### 1.07 LEAD-BASED PAINT DISPOSAL

**A.** At locations where LBP has been confirmed, the loose paint and debris generated during the removal process shall be tested to determine whether the material is classified as, and be disposed as hazardous waste, non-hazardous construction/demolition waste, or special waste. Contractor shall coordinate sampling and laboratory analysis by the TCLP on representative composite samples of the paint debris to determine proper disposal requirements. Results shall be submitted and approved by the Owner or Owner’s representative prior to the disposal of the waste debris.

**B.** All waste must be kept secured and labeled in accordance with 29 CFR 1910.145 – Signs and Tags, until analyzed by the TCLP test. If it is characterized as hazardous, the waste must be labeled in accordance with 49 CFR 172, 173, 178 and 179 Regulations for Labeling, Mailing and Transporting Hazardous Waste.

**C.** After the waste is characterized, it shall be disposed in accordance with all applicable local, federal, state and/or county regulations.

**D.** If the LBP debris is found to be hazardous waste by TCLP analysis \( \text{i.e. if TCLP concentrations of lead are } \geq 5 \text{ milligrams per liter (mg/L)}, \) all entities and/or individuals involved in the off-site removal and disposal work must possess valid permits and/or licenses required under the Resource Conservation and Recovery Act (RCRA) as well as any other federal, State or local permits or licenses required for removal, packaging, transportation and disposal of hazardous waste.

**E.** All hazardous waste (LBP debris failing the TCLP analysis) must be disposed by the Contractor at an Environmental Protection Agency (EPA) permitted Treatment, Storage and Disposal Facility (TSD).

### 1.08 QUALITY ASSURANCE
A. Contractor shall be licensed in the State of Tennessee.

B. Contractor shall certify that their employees or their subcontractor employees have prior experience on LBP projects similar in nature and extent to perform the work in a satisfactory manner and to comply with TOSHA/OSHA requirements for worker safety as defined in 29 CFR 1926.62 (Lead in Construction) and to comply with all State and Federal regulations regarding the disposal of LBP. Certification as a Tennessee Lead Paint Abatement firm is not required for this project, but will suffice as qualification.

C. Competent Person: Contractor shall certify that a full-time, on-site Competent Person is assigned to the LBP work, and meets the Competent Person requirements of 29 CFR 1926.62. The Competent Person shall be experienced in the administration and supervision of LBP projects (See OSHA definition of Competent Person in the definitions section).

D. Testing Laboratory: Contractor shall provide the name, address, and telephone number of the independent testing laboratory that will be used to perform analysis of air and/or waste (paint chip composite) samples. Documentation that the laboratory performing the analysis is an EPA National Lead Laboratory Accreditation Program (NLLAP) accredited laboratory and that it is rated proficient in the NIOSH/EPA Environmental Lead Proficiency Analytical Testing Program (ELPAT) will also be provided.

E. LBP Licensing Information and Training: Contractor firm and subcontractor personnel working on the site shall meet applicable federal, State and local licensing, information and training requirements for lead abatement projects, specifically those required by the TDEC DSHWM Lead Hazard Program and OSHA/TOSHA in 29 CFR 1926.62(l), “Employee information and training”.

1.09 REGULATORY REQUIREMENTS

A. All Work shall be performed in strict compliance with current federal, State and local regulations, codes and standards, as listed below:

1. OSHA
   a. 29 CFR 1910 General Industry Standard
   b. 29 CFR 1910.1025 Lead Hazard Standard
   c. 29 CFR 1910.134 Respiratory Protection
   d. 29 CFR 1910.1200 Hazard Communication
   e. 29 CFR 1910.145 Signs and Tags
   f. 29 CFR 1926 Construction Industry Standard
   g. 29 CFR 1926.62 Lead Standard for the Construction Industry

2. EPA

3. United States Department of Transportation (DOT)
   a. 49 CFR 172, 173, 178 and 179 Regulations for Labeling, Mailing and Transporting Hazardous Waste

4. State of Tennessee: Rules of the Tennessee Department of Labor and Workforce Development Occupational Safety and Health, Rules and Regulations of the State of Tennessee (Rules) Chapter 0800-1-6, the TOSHA has adopted the federal standards
under 29 CFR 1926]. TDEC DSHWM policy for the management and disposal of LBP debris is addressed in a policy letter dated September 1, 2000.

a. Chapter 1200-1-7: Solid Waste Processing and Disposal
b. Chapter 1200-1-11: Hazardous Waste Management

5. County and city codes and ordinances as applicable.

6. All attachments, memorandums, records of decision and information sheets submitted by federal, State and local agencies.

B. Any variance from applicable regulations shall have the prior written consent of the regulatory agency and the Designer and Owner. Any variance from the procedures and requirements of this specification shall have the prior written consent of the Designer and Owner.

1.10 SUBMITTALS

A. Abatement Submittals – Contractor must comply with any applicable submittals requirements in Section 01 33 43.

1.11 DELIVERY AND STORAGE

A. Store material subject to damage off the ground, away from wet or damp surfaces, and under cover sufficient to prevent damage or contamination.

B. Remove from the premises all damaged or deteriorating materials. Dispose of and/or decontaminate materials that become contaminated with LBP in accordance with applicable regulatory standards.

1.12 GENERAL PROTECTION OF PERSONS

A. Contractor is responsible for all personal protective equipment (PPE - clothing, respirators, etc.), engineering controls, and work practices to be used for the work specified herein (and specifically defined in Section 3 – Execution) and as required by OSHA/TOSHA regulations for Lead in Construction - 29 CFR 1926.62.

B. Prior to commencing work, Contractor shall ensure that all workers are instructed and knowledgeable in appropriate procedures of personnel protection for lead-containing paint work, specifically those required by OSHA/TOSHA in 29 CFR 1926.62(f), “Employee information and training”. In addition, the contractor must ensure that all its employees, and/or its subcontractor employees have reviewed the site-specific Health and Safety Plan for the work.

C. Contractor shall be solely responsible for enforcing worker protection requirements as required by 29 CFR 1926.62.

D. Contractor shall provide workers with personally issued respiratory protective equipment approved by NIOSH or MSHA. The respiratory equipment shall be suitable for protecting against lead exposures in the controlled areas according to OSHA Standard 29 CFR 1926.62 and OSHA 29 CFR 1910.134, Respiratory Protection. Filter cartridges that meet the criteria established in NIOSH 42 CFR 84 shall be selected, provided and replaced as required.
E. Contractor shall provide workers, Owner and/or Designer representatives, and authorized visitors with protective disposable clothing, head covers, gloves, eye protection and foot covers of various sizes to enter controlled areas. Contractor is not responsible for providing respiratory protection to anyone other than his/her employees.

F. Reporting Unusual Events: When an event of unusual and significant nature occurs at the site, a report listing the chain of events, persons participating, response and similar pertinent information shall be prepared and submitted to the Owner or Owner’s representative. When such events are known or predictable in advance, the Owner or Owner’s representative will be notified in advance, at the earliest possible date.

G. Reporting Accidents: Prepare and submit reports of significant accidents at the site. A significant accident includes events where personal injury is sustained, or property loss of substance is sustained.

H. Post telephone numbers and locations of emergency services including, but not limited to, fire, ambulance and police at the entrance to the decontamination unit.

1.13 SIGN IN/OUT LOG

A. Contractor shall maintain a Sign In/Out Log at the entrance to the controlled area(s). The log shall be maintained from the time the first removal activity is performed until the project is complete. All persons entering the controlled area(s), including Contractor’s workers, Owner’s representative and regulatory officials shall be required to sign in and out upon entering and exiting the controlled area. All persons shall record their name, time, company or agency represented and reason for entering the control area.

B. Except for Governmental Inspectors having jurisdiction, no visitors shall be allowed in any controlled area, except as authorized by Owner and Designer representatives.

1.14 SAFETY AND PROTECTION, OSHA/TOSHA COMPLIANCE

A. The Competent Person shall be the onsite person responsible for coordination, safety, security and execution of the work. The Competent Person shall be able to identify existing and predictable lead hazards and shall have the authority to take corrective measures to eliminate them.

PART 2: PRODUCTS

2.01 MATERIALS

A. Containers: Air and water-tight containers, suitable to receive and retain any lead-based paint debris or contaminated materials until TCLP analysis and subsequent disposal at an approved site, shall be utilized. All containers shall be labeled in accordance with OSHA Regulations 29 CFR 1926.62 and 1910.145, and/or DOT Regulations 49 CFR 172, 173, 178 and 179. Three types of containers may be used:

1. Six-mil plastic bags/sheet sized to fit within a drum or waste dumpster.
2. Metal or fiber drums with tightly fitting lids.
3. Waste dumpsters with lids.
B. Warning Labels and Signs will conform to OSHA regulation 29 CFR 1926.62 (Lead), DOT regulations 49 CFR 172, 173, 178 and 179 (Regulations for Labeling, Mailing and Transporting Hazardous Waste), and/or EPA regulations 40 CFR 260, 261, 262, 263, 264 and 265 (Hazardous Waste Regulations).

C. Polyethylene (poly) sheeting: 4-mil and 6-mil polyethylene sheets in sufficient sizes to minimize the frequency of joints.

D. Tape: Glass fiber or other type capable of sealing joints of adjacent plastic sheets and for attachment of plastic sheet to finished or unfinished surfaces of dissimilar materials under both dry and wet conditions.

PART 3: EXECUTION

3.01 REMOVAL OF LEAD-BASED AND LEAD-CONTAINING PAINT

A. Contractor shall prepare and remove paint from all specified surfaces scheduled for re-painting, and ensure that those surfaces are prepared for painting. Coordinate with painting contractor to ensure that methods and materials used for paint removal are compatible with new coatings. Paint removal of those items scheduled for demolition is not required.

B. Spaces included in the Work Areas shall be inspected by Contractor and any visible, larger paint debris shall be misted and swept or picked up, or HEPA-vacuumed prior to the establishment of controlled areas.

C. Controlled Areas: Before the removal of paint from specified components, Contractor shall establish and cordon off Work Areas to prevent entry by unauthorized personnel. Contractor shall also provide warning signs at each access point to the controlled area. To the extent practicable, these signs must be in the primary language of the occupants and workers. These signs must be posted before beginning the renovation and must remain in place and readable until the removal and cleaning verification has been completed.

D. Containing Work Areas. Before beginning the removal, the contractor must isolate the Work Area so that no dust or debris leaves the Work Area while the removal is being performed. The Work standard practices of EPA 40 CFR 745.85, “Lead; Renovation, Repair, and Painting Program, Standards for Renovation Activities” shall serve as a guideline. Contractor must maintain the integrity of the containment by ensuring that any plastic or other impermeable materials are not torn or displaced.

E. Establish a decontamination unit providing workers with soap, towels, and a shower for washing as necessary. Wastewater shall be stored for later treatment or filtered via 2-stage filters with the last filter being a 5-micron filter. Contractor is responsible for securing required approvals for discharge to sanitary sewer.

F. Paint Removal: Contractor shall remove paint from specified components in accordance with Design Documents. If necessary, a final HEPA vacuum should be conducted to ensure that all LBP dust and LBP chips are recovered.

   1. Prohibited and restricted practices. The work practices listed below shall be prohibited or restricted during abatement:

   a. Open-flame burning or torching of LBP.
b. Operating a heat gun on LBP is permitted only at temperatures below 1,100 degrees Fahrenheit.
c. Machine sanding or grinding without HEPA vacuum exhaust, which might damage substrate.
d. Uncontained hydroblasting on interior surfaces.
e. Abrasive blasting that might damage substrates.
f. Use of methylene chloride containing products.
g. Dry scraping.

2. If hidden conditions that could not be identified prior to the start of Work are encountered during the Work, and might adversely impact the Work, the conditions shall be reported to the Owner and Designer immediately.

G. Use precautions to ensure that all personnel, tools, and other items, including the exteriors of containers of waste are free of dust and debris before leaving the Work Area.

H. Cleaning. Cleaning is to be conducted in all Work Areas at the completion of specified component removal and paint removal. Cleaning requires the use of respiratory protection and protective clothing, or accepted negative Exposure Assessment. The contractor shall determine the level of protection required and shall document in records on job site.

I. Containerization: Contractor shall ensure that all LBP dust, chips, and stripping debris are captured and contained for analysis and disposal. Paint that is not LBP shall be captured and contained for disposal, but does not require testing by TCLP. Loose paint chips/debris on plastic sheeting can be swept or vacuumed into bags or contained by completely enclosing the paint chips/debris within the plastic sheeting. After the contractor has completed the removal of LBP, all LBP chips/paint debris shall be bagged and labeled pending composite sampling and the results of TCLP laboratory analysis for lead. Containers must be strong and sturdy enough to allow for ease of handling without the risk of tearing and loss of chips during handling and during off-site transportation and disposal as hazardous waste, special waste, or construction waste depending on the results of the TCLP analysis. Containerized paint chips/paint debris shall be staged onsite pending laboratory results and off-site disposal.

J. Composite Sampling: Contractor shall collect composite samples that are representative of the removed and containerized LBP debris. Contractor must consult with the laboratory conducting the TCLP analysis regarding composite sample containers, shipping, sample preservatives (if any), holding times, etc. The composite samples shall be collected by attempting to obtain a representative cross-section of removed paint chips from the LBP containers. The number of composite samples collected for laboratory analysis shall depend on the total volume of LBP paint chips/debris that is generated and be based on industry standards. Contractor must associate each composite sample with specific containers or groups of containerized LBP waste so that the waste is disposed appropriately depending on the results of the TCLP analysis.

K. Evaluation of TCLP Results and LBP Chip Disposal: Contractor shall evaluate the laboratory results of the TCLP analysis on the composite samples. TCLP results from LBP chips/debris that are \( \geq 5.0 \text{ mg/L} \) indicate that the waste is hazardous by toxicity, and that such chips/debris must be disposed of as hazardous waste in accordance with State and Federal regulations. If hazardous, the contractor shall coordinate off-site disposal of the LBP debris with a vendor approved by federal and State regulations for hazardous waste disposal.
If the TCLP results are ≤ 5.0 mg/L then the LBP debris may require a special waste permit for disposal or can be disposed along with other demolition/construction debris in a State-permitted Class I, II, III, or IV solid waste disposal facility. Contractor shall contact the TDEC DSHWM to determine whether or not the LBP debris requires a special waste permit, and if required, must apply for and receive a special waste approval notice from the DSHWM before proceeding with off-site disposal of the LBP debris. If the DSHWM does not require a special waste permit, then the LBP debris may be disposed along with other demolition debris.

3.02 TOSHA/OSHA HEALTH AND SAFETY COMPLIANCE

A. General: Contractor shall comply with all requirements of 29 CFR 1926.62, OSHA/TOSHA’s Lead Standard for the Construction Industry with regard to execution of the all Work, and with regard to the transportation, disposal, storage, and containment of lead or materials containing lead. The OSHA requirements apply to LBP surfaces and also to painted surfaces with lead concentrations below the standards for defining LBP (i.e., ≤ 0.5% and ≤ 1.0 mg/cm²). In addition, contractor employees must comply with the requirements of the Site-specific Health and Safety Plan.

B. Contractor shall complete the Work in such a manner as to ensure that airborne lead concentrations do not exceed 50 micrograms per cubic meter of air in the worker’s breathing zone based on personnel samples or an accepted Exposure Assessment, 30 micrograms per cubic meter of air elsewhere inside the controlled areas, and 5 micrograms per cubic meter outside the controlled areas.

C. Contractor shall ensure that any solvent used to remove paint has a flashpoint of 120 degrees Fahrenheit or higher and that appropriate engineering controls or respiratory protection is issued whenever the concentration of solvent vapor reaches 50% of the OSHA/TOSHA PEL, the NIOSH REL, or the ACGIH TLV, whichever is lower. Where solvents have a flashpoint less than 200 degrees, the Work Area shall be continuously monitored for flammable or combustible conditions by the contractor. All Work shall stop if 10% LEL is reached.

D. Exposure Assessment: With respect to the lead related tasks identified in Section 3.01, the contractor must perform an employee exposure assessment as defined in 29 CFR 1926.62(d). Under those OSHA/TOSHA requirements and in conjunction with the implementation of Section 3.01 above, Contractor, as the employer, shall collect personnel samples representative of a full shift including at least one sample for each job classification in each work area either for each shift or for the shift with the highest exposure level.

Until the Contractor performs the employee exposure assessment and documents that the employee(s) performing manual removal and demolition tasks are not exposed above the PEL (50 µg/m³), Contractor must treat employees performing those operations as if they were exposed above the PEL. This means providing respiratory protection, personal protective work clothing and equipment, change areas, hand washing facilities, biological monitoring, and training (as required by the standard) for manual tasks of removal and rehabilitation.

Alternatively, if Contractor has previous exposure assessment monitoring results, and the data were obtained in the last 12 months during work operations conducted under workplace conditions closely resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the operations defined in the current Work (i.e., Sections 3.01), then Contractor may rely on those results to satisfy all requirements as defined in
29 CFR 1926.62 (specifically in section (d)(3)(iii) and elsewhere as applicable); however, those data must be provided to the Owner and Owner’s representative for approval before work begins.

Otherwise, the results of the employee exposure assessment must be used by the contractor to comply with all other standards described in 29 CFR 1926.62 subparts (d)(4) through subpart (r).

E. Competent Person: Contractor shall assign a Competent Person to be present on the work site throughout the project to supervise, monitor, and document the project's health and safety provisions. A daily log shall be maintained that provides the results of any testing performed. The Competent Person shall:

1. Verify that training meets applicable requirements.
2. Ensure compliance with all applicable requirements of 29 CFR 1926.62.
3. Enforce work practices to minimize airborne concentrations of lead.
4. Ensure that workers are not exposed to airborne lead concentrations in excess of the PEL established by 29 CFR 1926.62.

3.03 MONITORING

A. Personnel Air Monitoring: Airborne concentrations of lead shall be monitored and analyzed in accordance with 29 CFR 1926.62 unless a negative Exposure Assessment is documented and accepted by the Designer. The Competent Person shall coordinate personnel air monitoring results to determine the effectiveness of engineering controls and work practices and the adequacy of PPE. The Owner and Designer shall be notified if any personnel air monitoring result equals or exceeds 30 μg/m³ of air and the contractor shall ensure compliance with OSHA/TOSHA regulations to ensure and maintain appropriate safety and health requirements.

3.04 CLEAN-UP AND INSPECTION FOR CONTROLLED AREAS

A. After the completion of work as described in Section 3.01 of this specification, final cleaning, and satisfactory inspection by contractor’s Supervisor, Contractor shall notify the Designer. The Designer’s representative shall perform a visual inspection of the areas where paint was removed and staging areas for containerized LBP debris. Final inspection may not be conducted until at least one hour after all cleaning is completed.

B. Areas that do not pass a visual inspection shall be corrected and re-inspected. Clearance testing shall be performed at the discretion of the Owner; however, Contractor shall assume that all Work Areas must meet the requirements of the Specifications. Owner’s Inspector shall don disposable shoe covers at a minimum, prior to entering the Work Area. If the Area is free of visible dust, the Inspector may conduct clearance wipe testing of surfaces including floors, window sills, and window troughs. If performed, clearance dust sampling and analyses shall be conducted in general accordance with procedures indicated by the U.S. Department of Housing and Urban Development’s Guidelines for the Evaluation and Control of Lead Based Paint in Housing. Lead clearance criteria for the project shall be that the remediated area is free of visible dust, and lead loading on surfaces is less than 40 micrograms per square foot for floors and less than 250 micrograms per square foot for window sills. If soil samples are collected from the drip line of the building (after exterior removal) or from waste storage areas, the criteria shall be less than 1,200 ppm.

C. If any clearance testing fails to meet the specified clearance criteria, the Inspector shall determine if the entire Work Area is re-cleaned or only limited areas are re-cleaned. Following re-cleaning, the
clearance testing process will be repeated. Contractor may be charged for any and all additional consultation and testing fees and expenses incurred by the Owner beyond the initial testing.

D. If Contractor wishes to conduct baseline soil or dust testing, he must use a Tennessee-licensed Lead Paint Inspector or Risk Assessor to collect the samples, and the samples shall be analyzed by a properly accredited laboratory. Results of such testing shall be submitted to the Designer within two days of collection and prior to clearance testing.

3.05 FIELD QUALITY CONTROL

A. Contractor is responsible for performing personnel (OSHA compliance) air monitoring throughout the duration of the project unless a negative Exposure Assessment is documented and accepted by the Designer. Personnel samples shall be collected as required for the Exposure Assessment to be performed by the contractor, and for each type of work task performed that disturbs paint containing lead. Contractor must also perform any other necessary tests required by regulations or codes and standards for the protection of his workers.

B. The Owner and Designer reserve the right to perform area air monitoring at any time during the project without notifying the contractor. Contractor shall cooperate with the Owner's representative and provide access to Work Areas as needed.
SECTION 02 86 00 – OTHER HAZARDOUS MATERIALS ABATEMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Furnishing of and paying for all labor, services, appliances, materials, equipment, insurance and permits necessary to carry out the abatement or removal of hazardous materials and/or conditions other than asbestos-containing materials (see Section 02 82 33 – Removal and Disposal of Asbestos-Containing Materials) and lead-containing or lead-based paint (see Section 02 83 19.13 – Lead-based and Lead-containing Paint Removal and Disposal) from Building 60 (new IPER Center site) on the ETSU campus in Johnson City, Tennessee, prior to selective interior renovations. Based on Site inspections, all of the following hazardous materials and/or conditions may be present in the structure:

1. Ozone-depleting substances (ODSs) may include Class I substances such as chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl chloroform; and Class II substances such as hydrochlorofluorocarbons (HCFCs).

2. Mercury-containing equipment may include fluorescent light tubes, high-pressure sodium- or mercury-vapor bulbs, Exit signs, thermometers, thermostats, and various electrical or mechanical switches. Equipment or appliances which potentially have mercury-containing thermostats may include ceiling-mounted space heaters, water heaters, air conditioners, water fountains, and other appliances.

3. PCB-containing equipment may include a variety of electrical equipment (transformers, light ballasts, liquid filled switches, capacitors, etc.). The primary potential source of PCBs observed is light fixture ballasts.

4. Miscellaneous hazardous chemicals may be present at the time of renovation and are covered in this Specification, including small quantities of household cleaners, paints, insecticides, disinfectants, detergents, bleach, smoke detectors and batteries, electronics, etc. Equipment that may contain petroleum products is present and may include compressors, motors, pumps, hydraulic cylinders, elevator equipment, etc. Compressed gas or air containers include fire extinguishers, and compressed air tanks.

5. Biological hazards may include bird carcasses and droppings.

B. The United States Environmental Protection Agency (EPA), United States Department of Labor Occupational Safety and Health Administration (OSHA), Tennessee OSHA (TOSHA), United States Department of Transportation (DOT), Tennessee DOT (TDOT), and the Tennessee Department of Environment and Conservation (TDEC) Division of Solid and Hazardous Waste Management (DSHWM) regulate the handling, transporting and disposal of ODSs, mercury, PCBs, petroleum products, and other miscellaneous hazardous and special wastes. During renovation, demolition, and/or stabilization activities which may disturb these materials, Contractor employees must be protected from exposures that exceed the OSHA/TOSHA permissible limits for these materials. Transportation, disposal, or recycling of these materials shall be performed in compliance with federal, State and local requirements.

C. Contractor shall identify, remove, and properly dispose of all types of PCB-, ODS-, and mercury-containing equipment and fixtures, petroleum-containing equipment, and other miscellaneous hazardous materials prior to specified renovation, demolition and/or disposal activities. Contractor must verify actual materials and conditions at the Site, and has ultimate responsibility to abate all hazardous materials and/or conditions prior to disturbance and disposal, including those encountered by Contractor but not previously identified by the Owner.
1.02 RELATED WORK

A. Section 00 31 26: Hazardous Materials Data

B. Section 01 33 43: Abatement Submittals

1.03 COORDINATION WITH OTHER WORK

A. Contractor shall confirm that all hazardous materials are properly removed before activities commence that might disturb these materials.

1.04 CONTRACTOR PLANS

A. Contractor shall prepare a written Plan that includes a description detailing plans of how the work will be conducted, plans for ensuring the health and safety of workers and visitors, and how workers and visitors will be protected from exposure to hazardous materials and/or conditions. At a minimum, the Plan shall address the following items:

1. Security procedures to prevent unauthorized entry into controlled areas and workspaces.
2. Health and safety plans for workers/employees conducting the removal, handling, and containerization of hazardous materials, and appropriate personal protective clothing and engineering controls.
3. Methods for disconnecting and/or removing petroleum, PCB, ODS, and mercury-containing equipment in ways that prevent releases of hazardous materials and ensure the health and safety of workers.
4. Plans for the containerization, labeling, and staging of items and materials after removal, and packaging of hazardous or contaminated materials in a way that minimizes exposure and contamination and facilitates proper off-site handling, transportation, and disposal.
5. Emergency evacuation for medical or safety reasons such that exposure will be minimized.
7. Methods for identifying and isolating suspect PCB-, ODS-, mercury- and petroleum-containing equipment, and miscellaneous chemicals and compounds.
8. Plans for effective supervision during the work.
9. Plans for coordinating the off-site disposal and/or recycling of materials.
10. Immediate notification of Owner and Owner’s Environmental Consultant, clean-up procedures, and decontamination sequence to be used should PCBs, ODSs, mercury, or petroleum compounds be released/encountered uncontained, and an emergency action Plan in the event of a spill or contact with eyes or skin. This Plan should be available at the work Site for referral and review by workers/employees, visitors, and the Owner/Owner representatives prior to entry into controlled areas.

1.05 QUALIFICATIONS OF PERSONNEL

A. All Contractor or subcontractor personnel involved with the work of this section must be trained in the hazards of PCBs, ODSs, mercury, and petroleum, as well as precautions to prevent exposure.

B. In the event that the Contractor or subcontractor involved with the Work shall respond to a spill or leak of PCB, ODSs, mercury, or petroleum, the personnel who clean up the spill shall possess a certificate of participation and successful completion of training in accordance with OSHA 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response.
1.06 APPLICABLE REGULATIONS AND REGULATING AGENCIES

A. General Federal Regulations/Regulatory Agencies:
2. OSHA 29 CFR 1926.59 – Hazard Communication
8. OSHA 29 CFR 1926 – Construction Industry Standard
11. Any applicable updates to 1.06.A.1-10.

B. Federal PCB Regulations/Regulatory Agencies:
1. EPA 40 CFR 761 – Polychlorinated Biphenyl Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
3. EPA 40 CFR 264 – Standards for Owners and Operators of Hazardous Waste Treatment
5. EPA Online Website Document – Question & Answer Manual for PCBs
7. Any applicable updates to 1.06.B.1-6.

C. Federal Ozone-Depleting Substances Regulations/Regulatory Agencies:

D. Federal Mercury Regulations/Regulatory Agencies:
2. EPA 40 CFR 264 – Standards for Owners and Operators of Hazardous Waste Treatment
4. EPA 40 CFR 260, 261, 264, etc. – Hazardous Waste Management System; Modification of the Hazardous Waste Program; Hazardous Waste Lamps; Final Rule – July 6, 1999
5. Any applicable updates to 1.06.D.1-4.

E. State of Tennessee Regulations:
1. Rule 1200-1-7 – Solid Waste Processing and Disposal
2. Rule 1200-1-11 – Solid and Hazardous Waste Management
3. TDEC DSHWM Policy Statement dated July 30, 1999 – Mercury-Containing Batteries and PCB Containing Ballasts and Transformers
5. TDEC DSHWM Policy Statement dated July 9, 1999 – Mercury-Containing Lamps
6. Any applicable updates to 1.06.E.1-5.

F. All attachments, memorandums, records of decision and information sheets submitted by federal, State and local agencies.
G. Any variance from applicable regulations shall have the prior written consent of the regulatory agency and the Owner's Environmental Consultant. Any variance from the procedures and requirements of this Specification shall have the prior written consent of the Owner's Environmental Consultant.

1.07 SUBMITTALS

A. Pre-Job Submittals – Contractor must comply with submittals requirements in Section 01 33 43: Abatement Submittals

B. Post-Job Submittals – Contractor must comply with submittals requirements in Section 01 33 43: Abatement Submittals

C. Records/Submittals during the work - Maintain security and safety logs showing names of persons entering the Work Area, date and time of entry and exit, record of any accidents, emergency evacuation and other safety and/or health incidents. Provide data to Owner as Post-Job Submittals.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Impermeable Containers: Air and water-tight, suitable to receive and retain any hazardous material-containing or contaminated equipment until disposal at an approved site, and labeled in accordance with OSHA Regulation 29 CFR 1910.1001 and 29 CFR 1926.1101, as well as EPA regulation 40 CFR Part 61, 29 CFR 1910.145, and 49 CFR 172, 173, 178 and 179. Three types of containers may be used:
   1. Six-mil plastic bags/sheet sized to fit within a drum or waste dumpster
   2. Metal or fiber drums with tightly fitting lids
   3. Waste dumpsters with lids


C. Polyethylene (poly) sheeting: 4-mil and 6-mil polyethylene sheets in sufficient sizes to minimize the frequency of joints.

D. Tape: Glass fiber or other type capable of sealing joints of adjacent plastic sheets and for attachment of plastic sheet to finished or unfinished surfaces of dissimilar materials under both dry and wet conditions.

PART 3 - EXECUTION

3.01 WORK PROCEDURES

A. Hazardous Materials work shall be performed in accordance with the written Plan submitted by the Contractor and approved by the Owner and Owner's Environmental Consultant. Procedures and equipment requiring limited occupational and environmental exposures to PCBs, ODSs, mercury, petroleum and/or biological hazards during related Work shall be in accordance with federal, State and local regulations. Associated waste shall be disposed in compliance with federal, State, and local regulations. The Contractor shall follow the minimum requirements defined below for the pre-renovation or selective demolition removal, handling, and disposal of items known or suspected to contain PCBs, ODSs, mercury, petroleum, and/or biological hazards.
1. PCBs:
   a. De-energize Equipment - Ensure that all electrical equipment is completely de-energized before attempting to remove any hazardous materials.
   b. Carefully remove the access cover to the equipment and/or fluorescent light fixtures to expose the ballast.
   c. Evaluate Equipment for PCB Label - Check all ballasts or other suspect electrical equipment for a “No PCB” label and consult available information on the historical manufacturers of transformer equipment. Ballasts, transformers, or other equipment without a “No PCB” label should be considered PCB-containing. If labeled as “No PCBs”, then the ballasts can be disposed as ordinary non-hazardous demolition waste debris along with other non-hazardous demolition debris. If not labeled, then the Contractor must assume the ballast contains PCBs ≥ 50ppm in the potting compound and handle as PCB bulk product waste.
   d. Remove ballasts without a “No PCB” label from the light fixture without disturbing or rupturing the ballast, and placed into a steel drum or UN shipping container that meets UN specifications.
   e. If included in the project, transformers suspected of containing PCBs shall be sampled unless historical research confirms content. Based on PCB content of < 50 ppm, 50 ppm to < 500 ppm, or ≥ 500 ppm, proper regulatory disposal or recycling shall be arranged.
   f. Label, manifest and package containers for transport in accordance with 40 CFR Part 761.
   g. Drum and Container Marking/Labeling – Drums and containers must be labeled to identify the out-of-service date (i.e., when drumming starts), and labeled using the EPA designated label as shown to the right.
   h. Temporary on-site drum and container storage: Place containers in a temporary storage area on-site pending off-site pickup and disposal.
   i. Coordinate off-site disposal with EPA-approved fluorescent light ballast recycling company, or contractor who will manage transport of PCB-containing oils and equipment.
   j. Coordinate transportation, waste manifesting/profiling, and disposal certification with the disposal/recycling firm.
   k. Provide final documentation of disposal certification to the Owner or Owner’s representative for their records.
   l. Detailed requirements relevant to the ballast and PCB oils disposal recommended above are found in the following sections of EPA regulations.
      (1) 40 CFR 761.40: Marking requirements. Drums with ballasts are “PCB Article Containers” and must be marked with a PCB label and labeled to note the out of service date, i.e., the date when the drumming process starts.
      (2) 40 CFR 761.45: Marking formats. Drums must be labeled with a “Caution Contains PCBs” label as shown in Figure 1 of 40 CFR 761.45.
      (4) 40 CFR 761.65 (c)(1): Storage for disposal. The regulation allows for temporary storage up to 30 days from the date of removal from service.
      (5) 40 CFR 761.207: Manifest general requirements. These requirements shall be addressed by the Contractor in concert with the disposal/recycling firm.
   m. Should PCB leaks originate or be detected during the equipment and/or ballast removal process:
      (1) Wear PPE specified in Contractor’s Plan (See Subparagraph 1.04 of this specification).
      (2) Place the leaking equipment and/or ballast in a double layer of 6-mil polyethylene sheeting or bags and seal with duct or fiber tape.
      (3) Place the wrapped equipment and/or ballast into a UN shipping container that meets UN specifications.
(4) Clean up the spill.
(5) Place contaminated clean-up debris and waste in a labeled steel drum or a shipping container that meets UN specifications.
(6) Dispose of the equipment and/or ballasts in accordance with requirements defined above, and consistent with EPA 40 CFR 761 and TDEC DSHWM regulations.

n. Contractor is solely responsible for ensuring the health and safety of all its employees during the conduct of the removal, handling, packaging, and loading of PCB wastes at the site. Should PCBs inadvertently contact worker's skin or eyes, the worker should immediately take appropriate action as outlined in the Contractor's Plan (refer to subparagraph 1.04 of this specification).

2. ODSs:
   a. Background: Under 40 CFR 82, EPA issued a Final Rule (May 14, 1993) promulgating regulations under Section 608 of the Clean Air Act that establish a recycling program for ozone-depleting refrigerants recovered during the servicing and disposal of air-conditioning or refrigeration equipment. Together with the prohibition (effective July 1, 1992) on venting during servicing, repair, and disposal of Class I and Class II substances, these regulations are intended to reduce emissions of ODSs to the environment. The regulations require that ODSs contained “in bulk” (i.e., with refrigerant charge intact) in appliances/equipment be removed prior to disposal. Section 608 contains requirements concerning the safe disposal of Class I and Class II substances. Contractor requirements regarding the safe disposal of potential ODSs from the building scheduled for demolition activities are provided below, consistent with those regulations.
   b. Any cooling/refrigeration units in or on the building have the potential to contain ODSs in the equipment. Class I substances include chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl chloroform. Class II substances include hydrochlorofluorocarbons (HCFCs). The equipment affected by the Rule includes disposal of most air-conditioning and refrigeration equipment including household air conditioners and refrigerators, commercial air conditioners, refrigerators, food coolers and freezers, and water fountains (among other equipment). Section M, The Safe Disposal Program, states that the final link in the disposal chain is responsible for assuring that refrigerant has been removed from equipment, although refrigerant can be removed before final disposal. The final processor could require that refrigerant be removed before acceptance. Contractor shall constitute this final link in the disposal chain with ultimate responsibility for compliance with ODS regulations.
   c. Contractor shall follow the minimum requirements listed below before building demolition to ensure the proper removal and recycling of any ODSs.
      (1) Work shall be performed by individuals trained and certified in accordance with EPA 40 CFR 82.
      (2) Work shall be performed in accordance with EPA 40 CFR 82, Refrigeration Recycling Regulation for Venting Prohibition.
      (3) Contractor shall identify all equipment potentially containing ODSs before equipment removal and ensure that all ODSs are safely recovered.
      (4) Contractor shall carefully inspect each piece of suspect equipment to identify potential ozone-depleting refrigerants. If the equipment contains ODSs with the charge intact, then trained technicians must safely recover the ODSs. Refrigerant lines cannot be cut by the Contractor before disposal as this is a violation of the statute and the regulations prohibiting venting of ODSs to the environment.
      (5) The equipment used to recover the refrigerant at or before disposal must meet a performance standard established by EPA in the 40 CFR 82 regulations.
      (6) Contractor shall provide documentation for ODS recovery as part of the post-job submittals package.
3. Mercury:
   a. Background: Mercury-based thermostats, thermometers, and fluorescent, high intensity discharge, high pressure sodium, mercury vapor, and metal halide lamp bulbs are all considered by TDEC to be mercury-containing materials that are regulated under Standards for Universal Waste Management (Per TDEC Rule 1200-1-11-.12 and equivalent Federal regulations). Conditionally Exempt Small Quantity Generators (CESQG’s) can dispose of 15 or less fluorescent tubes per month in a Subtitle D (non-hazardous waste) Sanitary Landfill; however, the total number of fluorescent tubes affected by the current project will exceed the 15 per month CESQG quantity. In terms of the disposal of mercury containing lamps from the subject buildings, the following options exist (per TDEC Policy Statement of July 9, 1999): 1) recycle the bulbs, 2) make a hazardous waste determination using TCLP testing, or have sufficient knowledge and information about the bulbs to prove they are not hazardous, or 3) handle the bulbs as a hazardous waste.
   b. In areas determined by the Designer, Contractor shall remove and assemble all mercury-containing thermostats, thermometers, and mercury-containing light bulbs or lamps in a pre-renovation phase, and process those bulbs by recycling. The TDEC provides a list of fluorescent light recyclers. Contractor shall recycle the bulbs (intact or crushed) using one of these TDEC recycling vendors or any other recycling vendor approved by the TDEC and the Owner/Owner’s Environmental Consultant before work commences.
   c. Contractor shall ensure that the assembly and containment of the materials does not allow for the release of mercury.
   d. Should mercury leaks be detected by Contractor or result from Contractor work during the lamp or equipment removal or crushing process the Contractor employees or its subcontractors shall:
      (1) Wear PPE specified in Contractor’s Plan (See Subparagraph 1.04 of this specification).
      (2) Isolate and clean up the mercury by applying amalgam powder to the contaminated surface.
      (3) Remove the amalgam/mercury mixture from the subject surface using a high efficiency particulate air (HEPA)-filtered mercury vacuum.
      (4) Use a mercury vapor analyzer to determine that clean up is complete (no detectable concentration).
      (5) Upon completion of the clean-up, dispose of the contaminated debris and vacuum filter in accordance with EPA 40 CFR 261 and applicable TDEC DSHWM regulations.
   e. Should mercury inadvertently contact worker’s skin or eyes, the worker should immediately take appropriate action as specified in Contractor’s Plan (See Subparagraph 1.04 of this specification).
   f. Contractor shall provide complete documentation for the disposal of all mercury-containing lamps removed as part of the post-job submittals package.

4. Petroleum Products:
   a. De-energize Equipment - Ensure that all electrical equipment is completely de-energized before attempting to remove any hazardous materials.
   b. Remove or drain petroleum product from tank, lines, or casing of equipment to the lowest level possible.
   c. If applicable, purge tank of petroleum vapors until inert and vapor levels are below the lower explosive limit (LEL) when tested by a combustible gas indicator. The tank may be made inert by adding solid carbon dioxide (dry ice). Before proceeding with cleaning, all dry ice must be evaporated.
   d. Equipment may be salvaged but if equipment is to be disposed after the tank is purged, cut hole in the tank remove residual tank bottoms and clean tank interior with high-pressure rinse. Recover waste and water, place in disposal drums and dispose of in accordance with all applicable regulations.
e. Following cleaning, equipment may be dismantled into manageable sections for scrap.
f. If necessary, clean floors, pads, or ground as necessary in the vicinity of the tanks.
g. Fuel oil contaminated water and waste shall be transported by a licensed waste hauler.

5. Miscellaneous hazardous chemicals and compounds: All hazardous chemicals not addressed in the previous sections shall be properly disposed of according to all applicable federal, State, and local regulations. These products may include, but are not limited to, cleaning supplies, electronics, batteries, smoke detectors, paint, insecticides, compressed air/gas canisters, etc.

6. Biological hazards:
   a. Set up proper containment and HEPA filtration as necessary to limit access; equip workers with proper PPE.
   b. Remove any bird carcasses.
   c. Relocate bird waste into staging piles and wet down to decrease potential airborne particle during removal. Place bulk debris into 6-mil plastic bags.
   d. Use a HEPA vacuum to remove remaining debris.
   e. Treat surfaces with a disinfecting solution following vacuuming.

END OF SECTION 02 86 00
SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:
   1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
   2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
   3. Laboratory Test Reports: For curing and sealing compounds, indicating compliance with requirements for low-emitting materials.

C. Design Mixtures: For each concrete mixture.

1.4 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. Comply with the following sections of **ACI 301 (ACI 301M)** unless modified by requirements in the Contract Documents:

1. "General Requirements."
2. "Formwork and Formwork Accessories."
3. "Reinforcement and Reinforcement Supports."
4. "Concrete Mixtures."
5. "Handling, Placing, and Constructing."
6. "Lightweight Concrete."

B. Comply with **ACI 117 (ACI 117M)**.

2.2 STEEL REINFORCEMENT

A. **Recycled Content of Steel Products**: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

C. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.

D. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.


2.3 CONCRETE MATERIALS

A. **Regional Materials**: Concrete shall be manufactured within 500 miles (800 km) of Project site from aggregates and cementitious materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Regional Materials: Concrete shall be manufactured within 500 miles (800 km) of Project site.

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

D. Cementitious Materials:

1. Portland Cement: ASTM C 150/C 150M, **Type II**
2. Fly Ash: ASTM C 618, Class C.

E. Normal-Weight Aggregate: ASTM C 33/C 33M, **1-3/4-inch** nominal maximum aggregate size.
F. Air-Entraining Admixture: ASTM C 260/C 260M.

G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

H. Water: ASTM C 94/C 94M.

2.4 RELATED MATERIALS

A. Vapor Retarder: Plastic sheet, ASTM E 1745, Class A or B.
B. Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick; or plastic sheet, ASTM E 1745, Class C.
C. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

2.5 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
B. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth or cotton mats.
C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
D. Water: Potable.
E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
F. Clear, Waterborne Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
   1. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.6 CONCRETE MIXTURES

A. Comply with ACI 301 (ACI 301M).
B. Normal-Weight Concrete:
1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Retain "Cementitious Materials" Subparagraph below if required for replacing part of the portland cement, which would otherwise be used in concrete, with other cementitious materials.
4. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, by not more than 40 percent.
5. slump Limit: 6 inches for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
6. Air Content: Maintain within range permitted by ACI 301 (ACI 301M). Do not allow air content of trowel-finished floor slabs to exceed 3 percent. Exterior concrete 4-6%.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116, and furnish batch ticket information.

1. When air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, construct, erect, brace, and maintain formwork according to ACI 301 (ACI 301M).

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR-RETARDER INSTALLATION

A. Install, protect, and repair vapor retarders according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.
1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended adhesive or joint tape.

3.4 STEEL REINFORCEMENT INSTALLATION

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

3.6 CONCRETE PLACEMENT

A. Comply with ACI 301 (ACI 301M) for placing concrete.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).

C. Do not add water to concrete during delivery, at Project site, or during placement.

D. Consolidate concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).

E. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated; and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Minimum Compressive Strength: 5000 psi (34.5 MPa) at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor them into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections exceeding 1/2 inch.
   1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch.
   1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following rubbed finish, defined in ACI 301 (ACI 301M), to smooth-formed-finished as-cast concrete where indicated:
   1. Smooth-rubbed finish.
   2. Grout-cleaned finish.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING UNFORMED SURFACES

A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface.
   1. Do not further disturb surfaces before starting finishing operations.

C. Scratch Finish: Apply scratch finish to surfaces indicated and surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes unless otherwise indicated.
D. Float Finish: Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, fluid-applied or direct-to-deck-applied membrane roofing, or sand-bed terrazzo.

E. Trowel Finish: Apply a hard trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.

F. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset methods. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.

G. Slip-Resistive Broom Finish: Apply a slip-resistive finish to surfaces indicated and to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.9 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 (ACI 301M) for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas...
subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Testing is the responsibility of the Contractor.

B. Tests: Perform according to ACI 301 (ACI 301M).

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

END OF SECTION 03 30 53
SECTION 03 41 00 - PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Precast structural concrete.
2. Precast structural concrete with commercial architectural finish.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for concrete topping and placing connection anchors in concrete.
2. Section 051200 "Structural Steel Framing" for furnishing and installing connections attached to structural-steel framing.
3. Section 055000 "Metal Fabrications" for kickers and other miscellaneous steel shapes.
4. Section 071900 "Water Repellents" for water-repellent finish treatments.

1.3 DEFINITIONS


1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
C. Design Mixtures: For each precast concrete mixture. Include compressive strength and, if required, water-absorption tests.

D. Shop Drawings:
   1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement.
   2. Detail fabrication and installation of precast structural concrete units, including connections at member ends and to adjoining construction.
   3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
   4. Indicate separate face and backup mixture locations and thicknesses.
   5. Indicate type, size, and length of welded connections by AWS standard symbols.
   6. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
   7. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
   8. Include and locate openings 6 inches and larger. Where additional structural support is required, include header design.
   9. Indicate location of each precast structural concrete unit by same identification mark placed on panel.
  10. Indicate relationship of precast structural concrete units to adjacent materials.
  11. Indicate locations, dimensions, and details of thin-brick units, including corner units and special shapes, and joint treatment.
  12. Indicate locations, dimensions, and details of stone facings, anchors, and joint widths.
  13. Indicate estimated camber for precast floor slabs with concrete toppings.
  14. Indicate shim sizes and grouting sequence.
  15. If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.

E. Samples:
   1. For each type of finish indicated on exposed surfaces of precast structural concrete units with architectural finish, in sets of three, representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches (300 by 300 by 50 mm).
      a. Where other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.
      b. Grout Samples for Initial Selection: Color charts consisting of actual sections of grout showing manufacturer's full range of colors.

F. Delegated-Design Submittal: For precast structural concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Show precast structural concrete unit types, connections, types of reinforcement, including special reinforcement, and concrete cover on reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from precast structural concrete.
1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, and testing agency.

B. Welding certificates.

C. Material Certificates: For the following:
   1. Cementitious materials.
   2. Reinforcing materials and prestressing tendons.
   3. Admixtures.
   5. Insulation.

D. Material Test Reports: For aggregates, by a qualified testing agency.

E. Preconstruction test reports.

F. Source quality-control reports.

G. Field quality-control and special inspection reports.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

   1. Designated as a PCI-certified plant as follows:
      a. Group C, **Category C2 - Prestressed Hollowcore and Repetitively Produced Products.**

B. Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance, to erect **Category S1 - Simple Structural Systems.**

C. Installer Qualifications: An experienced precast concrete erector who has retained a "PCI-Certified Field Auditor" to conduct a field audit of a project installed by erector in Category S1 – Simple and Category S2 - Complex Structural Systems and who can produce an Erectors' Post Audit Declaration, according to PCI MNL 127, "PCI Erector's Manual - Standards and Guidelines for the Erection of Precast Concrete Products."

D. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

E. Quality-Control Standard: For manufacturing procedures, testing requirements, and quality-control recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."

F. Welding Qualifications: Qualify procedures and personnel according to the following:

   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

1.8 PRECONSTRUCTION TESTING

1.9 COORDINATION

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.

B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.

1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
2. Place adequate dunnage of even thickness between each unit.
3. Place stored units so identification marks are clearly visible, and units can be inspected.

C. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.

D. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design precast structural concrete units.

B. Design Standards: Comply with ACI 318 (ACI 318M) and with design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.

C. Fire-Resistance Calculations: Where indicated, provide precast structural concrete units whose fire resistance meets prescriptive requirements of authorities having jurisdiction or has been calculated according to ACI 216.1 PCI MNL 124, "Design for Fire Resistance of Precast Prestressed Concrete," and is acceptable to authorities having jurisdiction.

D. Structural Performance: Precast structural concrete units and connections shall withstand design loads indicated within limits and under conditions indicated.

E. Structural Performance: Provide precast structural concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
1. Dead Loads: weight of all in place materials as shown on drawings
2. Concrete Topping Load: .35 psf
3. Live Loads: 100 psf
4. Seismic Loads: per IBC – AISC.
5. Design precast structural concrete framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements. Maintain precast structural concrete deflections within limits of ACI 318 (ACI 318M).
   a. Thermal Movements: Allow for in-plane thermal movements resulting from annual ambient temperature changes of minus 18 to plus 120 deg F (minus 10 to plus 67 deg C).

6. Fire-Resistance Rating: Select material and minimum thicknesses to provide indicated fire rating.

2.2 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
   1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

B. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

C. Surface Retarder: Chemical set retarder, capable of temporarily delaying setting of newly placed concrete mixture to depth of reveal specified.

2.3 REINFORCING MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

C. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420) ASTM A 706/A 706M, deformed bars, ASTM A 775/A 775M or ASTM A 934/A 934M epoxy coated, with less than 2 percent damaged coating in each 12-inch (300-mm) bar length.

D. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars, assembled with clips.

E. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from galvanized steel wire into flat sheets.

G. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, [plain], flat sheet, coating.

H. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.4 PRESTRESSING TENDONS

A. Pretensioning Strand: ASTM A 416/A 416M, or Grade 270 (Grade 1860), uncoated, seven-wire or low-relaxation strand.

B. Unbonded Post-Tensioning Strand: ASTM A 416/A 416M, Grade 270 (Grade 1860), uncoated, seven-wire, low-relaxation strand.

1. Coat unbonded post-tensioning strand with post-tensioning coating complying with ACI 423.7 and sheath with polypropylene tendon sheathing complying with ACI 423.7. Include anchorage devices and coupler assemblies.


2.5 CONCRETE MATERIALS

A. Regional Materials: Concrete shall be manufactured within 500 miles (800 km) of Project site from aggregates and cementitious materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Regional Materials: Concrete shall be manufactured within 500 miles (800 km) of Project site.

C. Portland Cement: ASTM C 150/C 150M, Type I or Type III, gray, unless otherwise indicated.

1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.

D. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
2. Metakaolin: ASTM C 618, Class N.
3. Silica Fume: ASTM C 1240, with optional chemical and physical requirement.
4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
5. Blended Hydraulic Cement: ASTM C 595/C 595M, Type IS, portland blast-furnace slag, or Type I (SM), slag-modified portland cement.

E. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33/C 33M, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand compatible with coarse aggregate to match approved finish sample.

F. Lightweight Aggregates: Except as modified by PCI MNL 116, ASTM C 330/C 330M, with absorption less than 11 percent.

G. Coloring Admixture: ASTM C 979/C 979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.

H. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.

I. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

J. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
7. Plasticizing Admixture: ASTM C 1017/C 1017M, Type I.
8. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
9. Corrosion-Inhibiting Admixture: ASTM C 1582/C 1582M.

2.6 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.

B. Carbon-Steel-Headed Studs: ASTM A 108, Grade 1010 through 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.

C. Carbon-Steel Castings: ASTM A 27/A 27M, Grade 60-30 (Grade 415-205).

D. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.

E. Carbon-Steel Structural Tubing: ASTM A 500/A 500M, Grade B or Grade C.

F. Deformed-Steel Wire or Bar Anchors: ASTM A 496/A 496M or ASTM A 706/A 706M.

G. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); carbon-steel, hex-head bolts and studs; carbon-steel nuts, and flat, unhardened steel washers, ASTM F 844.

H. High-Strength Bolts and Nuts: ASTM A 325 (ASTM A 325M) or Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A 563 (ASTM A 563M); and hardened carbon-steel washers, ASTM F 436 (ASTM F 436M).
I. Zinc-Coated Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M
   1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon and 2.5 times phosphorous content to 0.09 percent.
   2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.

J. Shop-Primed Finish: Prepare surfaces of nongalvanized-steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop apply SSPC-Paint 25 according to SSPC-PA 1.

K. Welding Electrodes: Comply with AWS standards.

L. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast structural concrete units.

2.7 STAINLESS-STEEL CONNECTION MATERIALS

A. Stainless-Steel Plate: ASTM A 666, Type 304, Type 316, or Type 201.

B. Stainless-Steel Bolts and Studs: ASTM F 593, Alloy Group 1 or 2 (ASTM F 738M, Grade A1 or A4), hex-head bolts and studs; ASTM F 594, Alloy Group 1 or 2 (ASTM F 836M, Grade A1 or A4) stainless-steel nuts; and flat, stainless-steel washers.
   1. Lubricate threaded parts of stainless-steel bolts with an antiseize thread lubricant during assembly.

C. Stainless-Steel-Headed Studs: ASTM A 276, Alloy 304 or 316, with minimum mechanical properties of PCI MNL 116.

2.8 BEARING PADS

A. Provide one of the following bearing pads for precast structural concrete units as recommended by precast fabricator for application:
   1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore, Type A durometer hardness, ASTM D 2240; minimum tensile strength 2250 psi (15.5 MPa), ASTM D 412.
   2. Random-Oriented-Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. 70 to 90 Shore, Type A durometer hardness, ASTM D 2240; capable of supporting a compressive stress of 3000 psi (20.7 MPa) with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
   3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; 80 to 100 Shore, Type A durometer hardness, ASTM D 2240; complying with AASHTO's "AASHTO LRFD Bridge Design Specifications," Division II, Section 18.10.2; or with MIL-C-882E.
   4. Frictionless Pads: PTFE, glass-fiber reinforced, bonded to stainless- or mild-steel plate, or random-oriented-fiber-reinforced elastomeric pads; of type required for in-service stress.

2.9 ACCESSORIES

A. Reglets: Specified in Section 076200 "Sheet Metal Flashing and Trim."

B. Reglets: Stainless steel, Type 302 or Type 304, felt or fiber filled, or with face opening of slots covered.

C. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install structural precast concrete units.

2.10 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C 150/C 150M, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.

B. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.

C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881/C 881M, of type, grade, and class to suit requirements.

2.11 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

1. Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, by not more than 40 percent.

2. Limit use of fly ash to 35 percent replacement of portland cement by weight and ground granulated blast-furnace slag to 20 percent of portland cement by weight; metakaolin and silica fume to 10 percent of portland cement by weight.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 116 when tested according to ASTM C 1218/C 1218M.

D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures or full-depth mixtures, at fabricator's option by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi (34.5 MPa).

2. Maximum Water-Cementitious Materials Ratio: 0.45.
E. Water Absorption: For structural precast concrete with an architectural finish, limit water absorption to 6 percent by weight or 14 percent by volume, tested according to ASTM C 642, except for boiling requirement.

F. Lightweight Concrete Backup Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.2, with materials to be used on Project, to provide lightweight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi (34.5 MPa).
2. Unit Weight: Calculated equilibrium unit weight of 115 lb/cu. ft. (1842 kg/cu. m), plus or minus 3 lb/cu. ft. (48 kg/cu. m), according to ASTM C 567.

G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.

H. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

I. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.12 MOLD FABRICATION

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.

B. Maintain molds to provide completed precast structural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

1. Form joints are not permitted on faces of structural precast concrete with an architectural finish that is exposed to view in the finished work.
2. Edge and Corner Treatment: Uniformly chamfered.

2.13 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.

D. Cast-in openings larger than 6 inches in any dimension. Do not drill or cut openings or prestressing strand.

E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
   1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcement exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
   2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
   3. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch (19-mm) minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches (38 mm) when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
   4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses and specified in-place loads.

G. Prestress tendons for precast structural concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 116.
   1. Delay detensioning or post-tensioning of precast, prestressed structural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete unit.
   2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
   3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
   4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.
   5. Protect strand ends and anchorages with a minimum of 1-inch- (25-mm-) thick, nonmetallic, nonshrink, grout mortar and sack rub surface. Coat or spray the inside surfaces of pocket with bonding agent before installing grout.

H. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
I. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch (25 mm) or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.

J. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.
   1. Place backup concrete mixture to ensure bond with face-mixture concrete.

K. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.
   1. Place self-consolidating concrete without vibration according to PCI TR -6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.

L. Comply with PCI MNL 116 procedures for hot- and cold-weather concrete placement.

M. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that does not show in finished structure.

N. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

O. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Architect's approval.

2.14 FABRICATION TOLERANCES

A. Fabricate precast structural concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 116 product dimension tolerances as well as position tolerances for cast-in items.

B. Thin-Brick-Faced Precast Structural Concrete Units: Restrict the following misalignments to 2 percent of number of thin bricks in a unit:
   1. Alignment of Mortar Joints:
      a. Jog in Alignment: 1/8 inch (3 mm).
      b. Alignment with Panel Centerline: Plus or minus 1/8 inch (3 mm).
   2. Variation in Width of Exposed Mortar Joints: Plus or minus 1/8 inch (3 mm).
   3. Tipping of Individual Thin Bricks from the Panel Plane of Exposed Thin-Brick Surface: Plus 0 inch (0 mm); minus 1/4 inch (6 mm) less than or equal to depth of form-liner joint.
   4. Exposed Thin-Brick Surface Parallel to Primary Control Surface of Panel: Plus 1/4 inch (6 mm); minus 1/8 inch (3 mm).
5. Individual Thin-Brick Step in Face from Panel Plane of Exposed Thin-Brick Surface: Plus 0 inch (0 mm); minus 1/4 inch (6 mm) less than or equal to depth of form-liner joint.

C. Stone Veneer-Faced Precast Structural Concrete Units:

1. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated: Plus or minus 1/4 inch (6 mm).
2. Variation in Joint Width: 1/8 inch in 36 inches (3 mm in 900 mm) or a quarter of nominal joint width, whichever is less.
3. Variation in Plane between Adjacent Stone Units (Lipping): 1/16-inch (1.6-mm) difference between planes of adjacent units.

2.15 COMMERCIAL FINISHES

A. Commercial Grade: Remove fins and protrusions larger than 1/8 inch (3 mm) and fill holes larger than 1/2 inch (13 mm). Rub or grind ragged edges. Faces must have true, well-defined surfaces. Air holes, water marks, and color variations are permitted. Limit form joint offsets to 3/16 inch (5 mm).

B. Standard Grade: Normal plant-run finish produced in molds that impart a smooth finish to concrete. Surface holes smaller than 1/2 inch (13 mm) caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are permitted. Fill air holes greater than 1/4 inch (6 mm) in width that occur more than once per 2 sq. in. (1300 sq. mm). Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Limit joint offsets to 1/8 inch (3 mm).

C. Grade B Finish: Fill air pockets and holes larger than 1/4 inch (6 mm) in diameter with sand-cement paste matching color of adjacent surfaces. Fill air holes greater than 1/8 inch (3 mm) in width that occur more than once per 2 sq. in. (1300 sq. mm). Grind smooth form offsets or fins larger than 1/8 inch (3 mm). Repair surface blemishes due to holes or dents in molds. Discoloration at form joints is permitted.

D. Grade A Finish: Repair surface blemishes and fill air holes with the exception of air holes 1/16 inch (1.6 mm) in width or smaller, and form marks where the surface deviation is less than 1/16 inch (1.6 mm). Float apply a neat cement-paste coating to exposed surfaces. Rub dried paste coat with burlap to remove loose particles. Discoloration at form joints is permitted. Grind smooth all form joints.

E. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. Major imperfections, honeycombing, or defects are not permitted.

F. Smooth, steel trowel finish unformed surfaces. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth, uniform finish.

G. Apply roughened surface finish according to ACI 318 (ACI 318M) to precast concrete units that receive concrete topping after installation.

2.16 COMMERCIAL ARCHITECTURAL FINISHES

A. Manufacture member faces free of joint marks, grain, and other obvious defects with corners, including false joints, uniform and straight. Finish exposed-face surfaces of precast concrete units to match approved sample panels and as follows:
1. PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers indicated.
2. As-Cast-Surface Finish: Provide surfaces to match approved sample or mockup for acceptable surface, air voids, sand streaks, and honeycomb.
3. Textured-Surface Finish: Impart by form liners or inserts.
4. Bushhammer Finish: Use power or hand tools to remove matrix and fracture coarse aggregates.
5. Exposed-Aggregate Finish: Use chemical-retarding agents applied to concrete molds and washing and brushing procedures to expose aggregate and surrounding matrix surfaces after form removal.
6. Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
7. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attach.
8. Honed Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
9. Polished Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
10. Sand-Embedment Finish: Use selected stones placed in a sand bed in bottom of mold, with sand removed after curing.

2.17 SOURCE QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified testing agency to evaluate precast structural concrete fabricator's quality-control and testing methods.
   1. Allow testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.

B. Testing: Test and inspect precast structural concrete according to PCI MNL 116 requirements and ASTM C 1610/C 1610M, ASTM C 1611/C 1611M, ASTM C 1621/C 1621M, and ASTM C 1712/C 1712M.
   1. Test and inspect self-consolidating concrete according to PCI TR-6.

C. Strength of precast structural concrete units is considered deficient if units fail to comply with ACI 318 (ACI 318M) requirements for concrete strength.

D. If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 (ACI 318M) requirements, employ a qualified testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.
   1. A minimum of three representative cores shall be taken from units of suspect strength, from locations directed by Architect.
   2. Test cores in an air-dry condition or, if units are wet under service conditions, test cores after immersion in water in a wet condition.
   3. Strength of concrete for each series of three cores is considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
4. Report test results in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports include the following:
   a. Project identification name and number.
   b. Date when tests were performed.
   c. Name of precast concrete fabricator.
   d. Name of concrete testing agency.
   e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

E. Patching: If core test results are satisfactory and precast structural concrete units comply with requirements, clean and dampen core holes and solidly fill with same precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

F. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Architect's approval. Architect reserves the right to reject precast units that do not match approved samples, sample panels, and mockups. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.
   C. Do not install precast concrete units until supporting, cast-in-place concrete has attained minimum allowable design compressive strength and until supporting steel or other structure is structurally ready to receive loads from precast concrete units.

3.2 INSTALLATION
   A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.
   B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until permanent connections are complete.
      1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
      2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
3. Remove projecting lifting devices and use plastic patch caps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.

4. For hollow-core slab voids used as electrical raceways or mechanical ducts, align voids between units and tape butt joint at end of slabs.

C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

1. Do not permit connections to disrupt continuity of flashing.

D. Field cutting of precast units is not permitted without approval of Engineer.

E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.

F. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

1. Protect precast structural concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.

2. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil- (0.1-mm-) thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780/A 780M.

3. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.

4. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.

G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.

2. For slip-critical connections, use one of the following methods to assure proper bolt pretension:


   d. Direct-Tension Control Bolt: ASTM F 1852.

3. For slip-critical connections, use method and inspection procedure approved by Architect and coordinated with inspection agency.

H. Grouting or Dry-Packing Connections and Joints: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled.
1. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces.
2. Fill joints completely without seepage to other surfaces.
3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels not steeper than 1 to 12.
4. Place grout end cap or dam in voids at ends of hollow-core slabs.
5. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
6. Keep grouted joints damp for not less than 24 hours after initial set.

3.3 ERECTION TOLERANCES

A. Erect precast structural concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.
B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Architect.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Contractor shall engage a qualified special inspector to perform the following special inspections:
   1. Erection of precast structural concrete members.
B. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections.
C. Visually inspect field welds and test according to ASTM E 165 or to ASTM E 709 and ASTM E 1444. High-strength bolted connections are subject to inspections.
D. Testing agency will report test results promptly and in writing to Contractor and Architect.
E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
F. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.
G. Prepare test and inspection reports.

3.5 REPAIRS

A. Repair precast structural concrete units if permitted by Architect and Engineer.
   1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.
B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).
C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780/A 780M.

D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

E. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Architect.

3.6 CLEANING

A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.

2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 03 41 00
SECTION 04 01 10 - MASONRY CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section includes cleaning the following:
   1. New Unit masonry surfaces.
   2. New Stone surfaces.

1.2 DEFINITIONS

A. Very Low-Pressure Spray: Under 100 psi (690 kPa).

B. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

C. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

D. High-Pressure Spray: 800 to 1200 psi (5510 to 8250 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to cleaning masonry including, but not limited to, the following:
      a. Verify masonry-cleaning equipment and facilities needed to make progress and avoid delays.
      b. Materials, material application, and sequencing.
      c. Cleaning program.

1.4 SEQUENCING AND SCHEDULING

A. Work Sequence: Perform masonry-cleaning work in the following sequence:
   1. Remove plant growth.
   2. Inspect for open mortar joints. Where repairs are required, delay further cleaning work until after repairs are completed, cured, and dried to prevent the intrusion of water and other cleaning materials into the wall.
   3. Remove paint.
   4. Clean masonry surfaces.
5. Where water repellents are to be used on or near masonry, delay application of these chemicals until after cleaning.

B. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units according to masonry repair Sections. Patch holes in mortar joints according to masonry repointing Sections.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include material descriptions and application instructions.
   2. Include test data substantiating that products comply with requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For paint-remover manufacturer and chemical-cleaner manufacturer.

B. Cleaning program.

1.7 QUALITY ASSURANCE

A. Paint-Remover Manufacturer Qualifications: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection, and on-site assistance.

B. Chemical-Cleaner Manufacturer Qualifications: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection, and on-site assistance.

C. Cleaning Program: Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, and equipment to be used; protection of surrounding materials; and control of runoff during operations. Include provisions for supervising worker performance and preventing damage.

   1. If materials and methods other than those indicated are proposed for any phase of cleaning work, add a written description of such materials and methods, including evidence of successful use on comparable projects and demonstrations to show their effectiveness for this Project.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit masonry-cleaning work to be performed according to product manufacturers' written instructions and specified requirements.

B. Clean masonry surfaces only when air temperature is 40 deg F and above and is predicted to remain so for at least seven days after completion of cleaning.
PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Mold, Mildew, and Algae Remover, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 5 quarts (5 L) of 5 percent sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every 5 gal. (20 L) of solution required.

E. Nonacidic Gel Cleaner: Manufacturer's standard gel formulation, with pH between 6 and 9, that contains detergents with chelating agents and is specifically formulated for cleaning masonry surfaces.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      
      a. Dumond Chemicals, Inc.
      b. Price Research, Ltd.
      c. PROSOCO, Inc.

F. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      
      a. American Building Restoration Products, Inc.
      b. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
      c. PROSOCO, Inc.

G. Mild-Acid Cleaner: Manufacturer's standard mild-acid cleaner containing no muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      
      a. American Building Restoration Products, Inc.
      b. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
      c. PROSOCO, Inc.

H. Acidic Cleaner: Manufacturer's standard acidic masonry cleaner composed of hydrofluoric acid or ammonium bifluoride blended with other acids, detergents, wetting agents, and inhibitors.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Building Restoration Products, Inc.
   b. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
   c. PROSOCO, Inc.

I. One-Part Limestone Acidic Cleaner: Manufacturer's standard one-part acidic formulation for cleaning limestone.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Building Restoration Products, Inc.
   b. EaCo Chem, Inc.
   c. PROSOCO, Inc.

J. Two-Part Chemical Cleaner: Manufacturer's standard system consisting of potassium- or sodium-hydroxide-based, alkaline prewash cleaner and acidic afterwash cleaner that does not contain hydrofluoric acid.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Price Research, Ltd.
   c. PROSOCO, Inc.

2.2 ACCESSORY MATERIALS

A. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Building Restoration Products, Inc.
   b. Price Research, Ltd.
   c. PROSOCO, Inc.

2.3 CHEMICAL CLEANING SOLUTIONS

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.

B. Acidic Cleaner Solution for Nonglazed Masonry and Unpolished Stone: Dilute acidic cleaner with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended in writing by chemical-cleaner manufacturer.
1. Stones: Use only on unpolished granite, unpolished dolomite marble, and siliceous sandstone.

PART 3 - EXECUTION

3.1 PROTECTION

A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent paint removers and chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents according to manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.

2. Do not apply chemical solutions during winds of enough force to spread them to unprotected surfaces.

3. Neutralize alkaline and acid wastes before disposal.

4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

B. Remove downspouts and associated hardware adjacent to immediate work area and store during masonry cleaning. Reinstall when masonry cleaning is complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 CLEANING MASONRY, GENERAL

A. Cleaning Appearance Standard: Cleaned surfaces shall have a uniform appearance as viewed from 20 feet away by Architect.

B. Proceed with cleaning in an orderly manner. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.

C. Use only those cleaning methods indicated for each masonry material and location.

1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.

2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage surfaces, including joints.

   a. Equip units with pressure gages.

   b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.

   c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
d. For high-pressure water-spray application, use fan-shaped spray that disperses water at an angle of at least 40 degrees.

e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

f. For steam application, use steam generator capable of delivering live steam at nozzle.

D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.

E. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed according to the "Cleaning Appearance Standard" Paragraph, so that cleaned surfaces blend smoothly into surrounding areas.

F. Water Application Methods:

   1. Water-Soak Application: Soak masonry surfaces by applying water continuously and uniformly to limited area for time indicated. Apply water at low pressures and low volumes in multiple fine sprays using perforated hoses or multiple spray nozzles. Erect a protective enclosure constructed of polyethylene sheeting to cover area being sprayed.

   2. Water-Spray Applications: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from masonry surface and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

G. Steam Cleaning: Apply steam to masonry surfaces at the very low pressures indicated for each type of masonry. Hold nozzle at least 6 inches (150 mm) from masonry surface and apply steam in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

H. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi (345 kPa). Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

I. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

   1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

J. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

3.3 PRELIMINARY CLEANING

A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open joints to whatever depth they occur.
B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar.

1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
2. Remove paint and calking with **alkaline paint remover**.
   b. Repeat application up to two times if needed.
3. Remove asphalt and tar with solvent-type paste paint remover.
   b. Apply paint remover only to asphalt and tar by brush without prewetting.
   c. Allow paint remover to remain on surface for 10 to 30 minutes.
   d. Repeat application if needed.

3.4 CLEANING MASONRY

A. Cold-Water Wash: Use cold water applied by medium-pressure spray.

B. Hot-Water Wash: Use hot water applied by medium-pressure spray.

C. Steam Cleaning: Apply steam at very low pressures not exceeding 30 psi (207 kPa) Insert value. Remove dirt softened by steam with wood scrapers, stiff-nylon or -fiber brushes, or cold-water wash, as indicated by cleaning tests.

D. Detergent Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold water applied by medium-pressure spray to remove detergent solution and soil.
4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

E. Mold, Mildew, and Algae Removal:

1. Wet surface with hot water applied by low-pressure spray.
2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
4. Rinse with hot water applied by medium-pressure spray to remove mold, mildew, and algae remover and soil.
5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.
F. **Nonacidic Gel Chemical Cleaning:**
   1. Wet surface with cold water applied by low-pressure spray.
   2. Apply gel cleaner in 1/8-inch (3-mm) thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
   3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
   4. Remove bulk of gel cleaner.
   5. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
   6. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

G. **Nonacidic Liquid Chemical Cleaning:**
   1. Wet surface with hot water applied by low-pressure spray.
   2. Apply cleaner to surface in two applications by brush or low-pressure spray.
   3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
   4. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
   5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

H. **Mild-Acid Chemical Cleaning:**
   1. Wet surface with cold water applied by low-pressure spray.
   2. Apply cleaner to surface in two applications by brush or low-pressure spray.
   3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
   4. Rinse with cold water applied by low medium-pressure spray to remove chemicals and soil.
   5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

I. **Acidic Chemical Cleaning:**
   1. Wet surface with cold water applied by low-pressure spray.
   2. Apply cleaner to surface in two applications by brush or low-pressure spray.
   3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
   4. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil. Rinse until all foaming, if any, stops and suds disappear.
   5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

J. **One-Part Limestone Chemical Cleaning:**
   1. Wet surface with hot water applied by low-pressure spray.
   2. Apply cleaner to surface by brush or low-pressure spray.
   3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
4. Immediately repeat application of one-part limestone cleaner as indicated above over the same area.
5. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.

K. Two-Part Chemical Cleaning:

1. Wet surface with hot water applied by low-pressure spray.
2. Apply alkaline prewash cleaner to surface by brush or roller.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer unless otherwise indicated.
4. Rinse with hot water applied by medium-pressure spray to remove chemicals and soil.
5. Apply acidic afterwash cleaner to surface in two applications, while surface is still wet, using low-pressure spray equipment, deep-nap roller or soft-fiber brush. Let neutralizer remain on surface for period recommended in writing by manufacturer unless otherwise indicated.
6. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil. Rinse until surface reaction value is between pH 5 and pH 9 according to pH-measuring paper, pen, or indicator solution.
7. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage paint-remover manufacturer's and chemical-cleaner manufacturer's factory-authorized service representatives for consultation and Project-site inspection and provide on-site assistance when requested by Architect. Have paint-remover manufacturer's and chemical-cleaner manufacturer's factory-authorized service representatives visit Project site not less than twice to observing progress and quality of the work.

3.6 FINAL CLEANING

A. Clean adjacent nonmasonry surfaces of spillage and debris. Use detergent and soft brushes or cloths.
B. Remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
C. Remove masking materials, leaving no residues that could trap dirt.

END OF SECTION 040110
SECTION 04 03 10 - HISTORIC MASONRY CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 028319.13 - Lead Based Paint Removal and Disposal

1.2 SUMMARY

A. Section includes historic treatment work consisting of cleaning historic clay brick and stone masonry surfaces.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.3 DEFINITIONS

A. Very Low-Pressure Spray: Less than 100 psi (690 kPa).

B. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

C. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

D. High-Pressure Spray: 800 to 1200 psi (5510 to 8250 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference on historic masonry cleaning at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to masonry historic treatment and cleaning.

2. Review methods and procedures related to cleaning historic masonry, including, but not limited to, the following:

   a. Historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
   b. Materials, material application, and sequencing.
   c. Quality-control program.
   d. Fire-protection plan.
   e. Cleaning program.
   f. Coordination with building occupants.
1.5 SEQUENCING AND SCHEDULING

A. Work Sequence: Perform historic masonry cleaning work in the following sequence:

1. Remove plant growth.
2. Inspect masonry for open mortar joints. Where repairs are required, delay further cleaning work until after repairs are completed, cured, and dried to prevent the intrusion of water and other cleaning materials into the wall. Note: clean a portion of the wall accessible by the design team for usage in evaluating color of repointing mortar against clean joints.
3. Remove paint.
4. Clean masonry.
5. Where water repellents or graffiti-resistant coatings are to be used on or near masonry work, delay application of these chemicals until after cleaning.

B. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units according to historic masonry repair Sections. Patch holes in mortar joints according to historic masonry repointing Sections.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include material descriptions and application instructions.
2. Include test data substantiating that products comply with requirements.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For historic treatment specialists including field supervisors and workers paint-remover manufacturer and chemical-cleaner manufacturer.

B. Preconstruction Test Reports: For cleaning materials and methods.

C. Quality-control program.

D. Cleaning program.

1.8 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic masonry cleaning specialist. Experience cleaning new masonry work is insufficient experience for historic treatment work.

B. Paint-Remover Manufacturer Qualifications: A firm regularly engaged in producing masonry paint removers that have been used for similar applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection, preconstruction product testing, and on-site assistance.

C. Chemical-Cleaner Manufacturer Qualifications: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-authorized service.
representatives who are available for consultation and Project-site inspection, preconstruction product
testing, and on-site assistance.

D. Quality-Control Program: Prepare a written quality-control program for this Project to systematically
demonstrate the ability of personnel to properly follow methods and use materials and tools without
damaging masonry. Include provisions for supervising performance and preventing damage.

E. Cleaning Program: Prepare a written cleaning program that describes cleaning process in detail, including
materials, methods, sequence, and equipment to be used; protection of surrounding materials; and control
of runoff during operations.

1. If materials and methods other than those indicated are proposed for any phase of cleaning work,
add to the quality-control program a written description of such materials and methods, including
evidence of successful use on comparable projects, and demonstrations to show their
effectiveness for this Project.

F. Mockups: Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set
quality standards for materials and execution.

1. Cleaning: Clean an area approximately 25 sq. ft. (2.3 sq. m) for each type of masonry and surface
condition.

   a. Test cleaners and methods on samples of adjacent materials for possible adverse
      reactions. Do not test cleaners and methods known to have deleterious effect.
   b. Allow a waiting period of not less than seven days after completion of sample cleaning to
      permit a study of sample panels for negative reactions.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents
contained in mockups unless Architect specifically approves such deviations in writing.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified historic treatment specialist or one or more chemical-
cleaner and paint-remover manufacturers to perform preconstruction testing on masonry surfaces.

1. Use test areas as indicated and representative of proposed materials and existing construction.
2. Propose changes to materials and methods to suit Project.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions
permit masonry cleaning work to be performed according to product manufacturers’ written instructions
and specified requirements.

B. Clean masonry surfaces only when air temperature is 40 deg F (4 deg C) and above and is predicted to
remain so for at least seven days after completion of cleaning.
PART 2 - PRODUCTS

2.1 PAINT REMOVERS

A. Alkaline Paste Paint Remover: Manufacturer's standard alkaline paste or gel formulation, for removing paint from masonry; and containing no methylene chloride.
   1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
      b. EaCo Chem, Inc.
      c. PROSOCO, Inc.
      d. Shore Corporation.

B. Covered or Skin-Forming Alkaline Paint Remover: Manufacturer's standard covered or skin-forming, alkaline paste or gel formulation, for removing paint from masonry; and containing no methylene chloride.
   1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
      a. American Building Restoration Products, Inc.
      b. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
      c. Dumond Chemicals, Inc.

C. Solvent-Type Paste Paint Remover: Manufacturer's standard water-rinsable, solvent-type paste or gel formulation, for removing paint from masonry.
   1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
      b. PROSOCO, Inc.
      c. Shore Corporation.

D. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from masonry; and containing no methanol or methylene chloride.
   1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
      a. Dumond Chemicals, Inc.
      b. EaCo Chem, Inc.
      c. PROSOCO, Inc.

E. Covered, Solvent-Type Paste Paint Remover: Manufacturer's standard, low-odor, covered, water-rinsable, solvent-type paste or gel formulation for removing paint from masonry; and containing no methanol or methylene chloride.
   1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Dumond Chemicals, Inc.
      b. PROSOCO, Inc.
2.2 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Mold, Mildew, and Algae Remover, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 5 quarts (5 L) of 5 percent sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every 5 gal. (20 L) of solution required.

E. Nonacidic Gel Cleaner: Manufacturer's standard gel formulation, with pH between 6 and 9, that contains detergents with chelating agents and is specifically formulated for cleaning masonry surfaces.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. Dumond Chemicals, Inc.
   b. Price Research, Ltd.
   c. PROSOCO, Inc.

F. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. American Building Restoration Products, Inc.
   b. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
   c. Dumond Chemicals, Inc.
   d. PROSOCO, Inc.

G. Mild-Acid Cleaner: Manufacturer's standard mild-acid cleaner containing no muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. American Building Restoration Products, Inc.
   b. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
   c. PROSOCO, Inc.

H. Acidic Cleaner: Manufacturer's standard acidic masonry cleaner composed of hydrofluoric acid or ammonium bifluoride blended with other acids, detergents, wetting agents, and inhibitors.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. American Building Restoration Products, Inc.
   b. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
   c. EaCo Chem, Inc.
I. One-Part Limestone Acidic Cleaner: Manufacturer's standard one-part acidic formulation for cleaning limestone.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. American Building Restoration Products, Inc.
   b. EaCo Chem, Inc.
   c. PROSOCO, Inc.

J. Two-Part Chemical Cleaner: Manufacturer's standard system consisting of potassium- or sodium-hydroxide-based, alkaline prewash cleaner and acidic afterwash cleaner that does not contain hydrofluoric acid.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   b. Price Research, Ltd.
   c. PROSOCO, Inc.

2.3 ACCESSORY MATERIALS

A. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. American Building Restoration Products, Inc.
   b. Price Research, Ltd.
   c. PROSOCO, Inc.

B. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Minimal possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could do the following:
   a. Remove, alter, or harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in contract.
   b. Leave residue on surfaces.

2.4 CHEMICAL-CLEANING SOLUTIONS

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.
B. Acidic Cleaner Solution for Brick and Unpolished Stone: Dilute acidic cleaner with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended in writing by chemical-cleaner manufacturer.

1. Stones: Use only on unpolished granite, unpolished dolomite marble, and siliceous sandstone.

C. Acidic Cleaner Solution for Polished Stone: Dilute acidic cleaner with water to concentration demonstrated by testing that does not etch or otherwise damage terra cotta surface, but not greater than that recommended in writing by chemical-cleaner manufacturer.

1. Stones: Use only on polished granite and polished dolomite marble.

PART 3 - EXECUTION

3.1 PROTECTION

A. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during masonry cleaning. Reinstall when masonry cleaning is complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.2 CLEANING MASONRY, GENERAL

A. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 20 feet (6 m) away by Architect.

B. Proceed with cleaning in an orderly manner; work from top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.

C. Use only those cleaning methods indicated for each masonry material and location.

1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage masonry.
   a. Equip units with pressure gauges.
   b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
   c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
   d. For high-pressure water-spray application, use fan-shaped spray that disperses water at an angle of at least 40 degrees.
   e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.
   f. For steam application, use steam generator capable of delivering live steam at nozzle.
D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.

E. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed according to the "Cleaning Appearance Standard" Paragraph above, so that cleaned surfaces blend smoothly into surrounding areas.

F. Water Application Methods:

1. Water-Soak Application: Soak masonry surfaces by applying water continuously and uniformly to limited area for time indicated. Apply water at low pressures and low volumes in multiple fine sprays using perforated hoses or multiple spray nozzles. Erect a protective enclosure constructed of polyethylene sheeting to cover area being sprayed.

2. Water-Spray Applications: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from masonry surface, and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

G. Steam Cleaning: Apply steam to masonry surfaces at the very low pressures indicated for each type of masonry. Hold nozzle at least 6 inches (150 mm) from masonry surface, and apply steam in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

H. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi (345 kPa). Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

I. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

J. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

3.3 PRELIMINARY CLEANING

A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open masonry joints to whatever depth they occur.

B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar.

1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.

2. Remove paint and calking with alkaline paint remover.
3. Remove asphalt and tar with solvent-type paste paint remover.
   b. Apply paint remover only to asphalt and tar by brush without prewetting.
   c. Allow paint remover to remain on surface for 10 to 30 minutes.
   d. Repeat application if needed.

3.4 PAINT REMOVAL

A. Paint-Remover Application, General: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

B. Paint Removal with Alkaline Paste Paint Remover:
   1. Remove loose and peeling paint using the lowest effective pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
   2. Apply paint remover to dry, painted surface with brushes.
   3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
   4. Rinse with hot water applied by lowest effective-pressure spray to remove chemicals and paint residue.
   5. Repeat process if necessary to remove all paint.
   6. Apply acidic cleaner or manufacturer's recommended afterwash to surface, while surface is still wet, using low-pressure spray equipment or soft-fiber brush. Let cleaner or afterwash remain on surface as a neutralizing agent for period recommended in writing by chemical-cleaner or afterwash manufacturer.
   7. Rinse with cold water applied by lowest effective-pressure spray to remove chemicals and soil.

C. Paint Removal with Covered or Skin-Forming Alkaline Paint Remover:
   1. Remove loose and peeling paint using lowest effective-pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
   2. Apply paint remover to dry, painted surface with trowel, spatula, or as recommended in writing by manufacturer.
   3. Apply cover according to manufacturer's written instructions.
   4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
   5. Scrape off paint and remover.
   6. Rinse with hot water applied by lowest effective-pressure spray to remove chemicals and paint residue.
   7. Apply acidic cleaner or manufacturer's recommended afterwash to surface, while surface is still wet, using low-pressure spray equipment or soft-fiber brush. Let cleaner or afterwash remain on surface as a neutralizing agent for period recommended in writing by chemical-cleaner or afterwash manufacturer.
   8. Rinse with cold water applied by lowest effective-pressure spray to remove chemicals and soil.
9. For spots of remaining paint, apply alkaline paste paint remover according to "Paint Removal with Alkaline Paste Paint Remover" Paragraph.

D. Paint Removal with Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using low-pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to painted surface with natural-fiber cleaning brush, deep-nap roller, or large paint brush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Rinse with hot water applied by low-pressure spray to remove chemicals and paint residue.

E. Paint Removal with Covered, Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using low-pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with trowel, spatula, or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with hot water applied by low-pressure spray to remove chemicals and paint residue.

3.5 CLEANING BRICKWORK

A. Use gentlest method below (first methods being more gentle than later methods) established in preconstruction test.

B. Cold-Water Wash: Use cold water applied by low-pressure spray.

C. Hot-Water Wash: Use hot water applied by low-pressure spray.

D. Steam Cleaning: Apply steam at very low pressures not exceeding 30 psi (207 kPa). Remove dirt softened by steam with wood scrapers, stiff-nylon or -fiber brushes, or cold-water wash, as indicated by cleaning tests.

E. Detergent Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold water applied by low-pressure spray to remove detergent solution and soil.
4. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup.
F. Mold, Mildew, and Algae Removal:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
4. Rinse with cold water applied by medium-pressure spray to remove mold, mildew, and algae remover and soil.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup.

G. Nonacidic Gel Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply gel cleaner in 1/8-inch (3-mm) thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer and established by mockup.
4. Remove bulk of gel cleaner.
5. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.
6. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

H. Nonacidic Liquid Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer established by mockup.
4. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

I. Mild-Acid Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer established by mockup.
4. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

J. Acidic Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer established by mockup.
4. Rinse with cold water applied by low-pressure spray to remove chemicals and soil. Rinse until all foaming, if any, stops and suds disappear.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

3.6 CLEANING UNPOLISHED STONEWORK

A. Use gentlest method below (first methods being more gentle than later methods) established in preconstruction test.

B. Cold-Water Wash: Use cold water applied by medium-pressure spray.

C. Hot-Water Wash: Use hot water applied by medium-pressure spray.

D. Steam Cleaning: Apply steam at very low pressures not exceeding 30 psi (207 kPa). Remove dirt softened by steam with wood scrapers, stiff-nylon or -fiber brushes, or cold-water wash, as indicated by cleaning tests.

E. Detergent Cleaning:
   1. Wet surface with cold water applied by low-pressure spray.
   2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
   3. Rinse with cold water applied by low-pressure spray to remove detergent solution and soil.
   4. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup.

F. Mold, Mildew, and Algae Removal:
   1. Wet surface with cold water applied by low-pressure spray.
   2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
   3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
   4. Rinse with hot water applied by medium-pressure spray to remove mold, mildew, and algae remover and soil.
   5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup.

G. Nonacidic Gel Chemical Cleaning:
   1. Wet surface with cold water applied by low-pressure spray.
   2. Apply gel cleaner in 1/8-inch (3-mm) thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer established by mockup.
4. Remove bulk of gel cleaner.
5. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.
6. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

H. Nonacidic Liquid Chemical Cleaning:

1. Wet surface with hot water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer established by mockup.
4. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

I. Mild-Acid Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer established by mockup.
4. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

J. Acidic Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer established by mockup.
4. Rinse with cold water applied by low-pressure spray to remove chemicals and soil. Rinse until all foaming, if any, stops and suds disappear.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

K. One-Part Limestone Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer established by mockup.
4. Immediately repeat application of one-part limestone cleaner as indicated above over the same area.
5. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.

L. Two-Part Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply alkaline prewash cleaner to surface by brush or roller.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer and established by mockup unless otherwise indicated.
4. Rinse with hot water applied by medium-pressure spray to remove chemicals and soil.
5. Apply acidic afterwash cleaner to terra cotta in two applications, while surface is still wet, using low-pressure spray equipment, deep-nap roller or soft-fiber brush.
6. Let neutralizer remain on surface for period recommended in writing by manufacturer unless otherwise indicated.
7. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.
8. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

3.7 FINAL CLEANING

A. Clean adjacent nonmasonry surfaces of spillage and debris. Use detergent and soft brushes or cloths.
B. Remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
C. Remove masking materials, leaving no residues that could trap dirt.

3.8 FIELD QUALITY CONTROL

A. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.
B. Notify Architect's Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until inspectors and Architect's Project representatives have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.
C. Manufacturer's Field Service: Engage paint-remover manufacturer's and chemical-cleaner manufacturer's factory-authorized service representatives for consultation and Project-site inspection, to perform preconstruction product testing, and provide on-site assistance when requested by Architect. Have paint-remover manufacturer's and chemical-cleaner manufacturer's factory-authorized service representatives visit Project site not less than twice to observe progress and quality of the Work.

END OF SECTION 04 03 10
SECTION 04 03 22 - HISTORIC BRICK UNIT MASONRY REPAIR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes historic treatment work consisting of repairing historic clay brick masonry as follows:
   1. Repairing unit masonry, including replacing units.
   2. Removing abandoned anchors.
   3. Painting steel uncovered during the work.
   4. Reanchoring veneers.

B. Related Requirements:
   1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
   2. Section 024296 "Historic Removal and Dismantling" for historic removal and dismantling work.
   3. Section 076200 "Sheet Metal Flashing and Trim" for metal flashing installed in or on repaired masonry.

1.3 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

B. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

C. Saturation Coefficient: Ratio of the weight of water absorbed during immersion in cold water to weight absorbed during immersion in boiling water; used as an indication of resistance of masonry units to freezing and thawing.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference on historic masonry repair and repointing at Project site.
   1. Review minutes of Preliminary Historic Treatment Conference that pertain to masonry historic treatment and repair.
   2. Review methods and procedures related to repairing historic brick masonry, including, but not limited to, the following:
      a. Historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
      b. Materials, material application, sequencing, tolerances, and required clearances.
c. Quality-control program.
d. Fire-protection plan.
e. Unit masonry historic treatment program.
f. Coordination with building occupants.

1.5 SEQUENCING AND SCHEDULING

A. Order sand and gray portland cement for colored mortar immediately after approval of Samples mockups. Take delivery of and store at Project site a sufficient quantity to complete Project.

B. Work Sequence: Perform masonry historic treatment work in the following sequence, which includes work specified in this and other Sections:

1. Remove plant growth.
2. Inspect masonry for open mortar joints and repair before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
3. Remove paint.
4. Clean masonry.
5. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
6. Repair masonry, including replacing existing masonry with new masonry materials.
7. Rake out mortar from joints to be repointed.
8. Point mortar and sealant joints.
9. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
10. Where water repellents are to be used on or near masonry work, delay application of these chemicals until after pointing and cleaning.
11. Sequence work to protect new windows from exposure to mortar and processes and products associated with brick masonry repair work.

C. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units according to "Masonry Unit Patching" Article. Patch holes in mortar joints according to Section 040323 "Historic Brick Unit Masonry Repointing."

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include recommendations for product application and use. Include test data substantiating that products comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of masonry repair work on the structure.
2. Show full-size patterns with complete dimensions for new molded brick shapes and brick arches and their jointing, showing relationship of existing units to new units.
3. Show provisions for expansion joints or other sealant joints.
4. Show provisions for flashing, lighting fixtures, conduits, and weep holes as required.
5. Show replacement and repair anchors. Include details of anchors within individual masonry units, with locations of anchors and dimensions of holes and recesses in units required for anchors.
6. Show locations of scaffolding and points of scaffolding in contact with masonry. Include details of each point of contact or anchorage.

C. Samples for Initial Selection: For the following:

1. Colored Mortar: Submit sets of mortar that will be left exposed in the form of sample mortar strips, 6 inches (150 mm) long by 3/8 inch wide, set in aluminum or plastic channels.
   a. Have each set contain a close color range of at least six Samples of different mixes of colored sands and cements that produce a mortar matching the existing, cleaned mortar when cured and dry.
   b. Submit with precise measurements on ingredients, proportions, gradations, and sources of colored sands from which each Sample was made.

2. Sand Types Used for Mortar: Minimum 8 oz. (240 mL) of each in plastic screw-top jars.
   a. For blended sands, provide Samples of each component and blend. Identify blend ratio.
   b. Identify sources, both supplier and quarry, of each type of sand.

3. Patching Compound: Submit sets of patching compound Samples in the form of plugs (patches in drilled holes) in sample units of masonry representative of the range of masonry colors on the building.
   a. Have each set contain a close color range of at least six Samples of different mixes of patching compound that match the variations in existing masonry when cured and dry.

4. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For the following:

1. Each type of masonry unit to be used for replacing existing units. Include sets of Samples to show the full range of shape, color, and texture to be expected.
   a. For each brick type, provide straps or panels containing at least four bricks. Include multiple straps for brick with a wide range.

2. Each type of patching compound in the form of briquettes, at least 3 inches (75 mm) long by 1-1/2 inches (38 mm) wide. Document each Sample with manufacturer and stock number or other information necessary to order additional material.

3. Accessories: Each type of anchor, accessory, and miscellaneous support.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For historic treatment specialists including field supervisors and workers and testing service.

B. Preconstruction Test Reports: For existing masonry units and mortar and replacement masonry units.

C. Quality-control program.
D. Unit masonry historic treatment program.

1.8 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic brick masonry repair specialist. Experience installing standard unit masonry is insufficient experience for masonry historic treatment work.

1. Historic Treatment Worker Qualifications: When masonry units are being patched, assign at least one worker per crew who is trained and certified by manufacturer of patching compound to apply its products.

B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising worker performance and preventing damage.

C. Unit Masonry Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for each phase of historic treatment work, including protection of surrounding materials and Project site.

1. Include methods for keeping exposed mortar damp during curing period.
2. If materials and methods other than those indicated are proposed for any phase of historic treatment work, add to the quality-control program a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.

D. Mockups: Prepare mockups of historic treatment to demonstrate aesthetic effects and to set quality standards for materials and execution, and for fabrication and installation.

1. Masonry Repair: Prepare sample areas for each type of masonry material indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches (1200 mm) in least dimension. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

   a. Replacement: Four brick units replaced.
   b. Reanchoring Veneers: Install three masonry repair anchors in mockup wall assembly of each anchor type required.
   c. Patching: Three small holes at least 1 inch (25 mm) in diameter for each type of brick material indicated to be patched, so as to leave no evidence of repair.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on masonry units as follows:

1. Provide test specimens as indicated and representative of proposed materials and existing construction.
2. Replacement Brick: Test each proposed type of replacement masonry unit, according to sampling and testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, five-hour boil absorption, saturation coefficient, and initial rate of absorption (suction).

3. Existing Brick: Test each type of existing masonry unit indicated for replacement, according to testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, five-hour boil absorption, saturation coefficient, and initial rate of absorption (suction). Carefully remove five existing units from locations designated by Architect. Take testing samples from these units.

4. Existing Mortar: Test according to ASTM C 295, modified as agreed by testing service and Architect for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength. Use X-ray diffraction, infrared spectroscopy, and differential thermal analysis to supplement microscopical methods. Carefully remove existing mortar from within joints at five locations designated by testing service and approved by Architect.

5. Temporary Patch: As directed by Architect, provide temporary materials followed by permanent repairs at locations from which existing samples were taken.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver masonry units to Project site strapped together in suitable packs or pallets or in heavy-duty cartons and protected against impact and chipping.

B. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

E. Store lime putty covered with water in sealed containers.

F. Store sand where grading and other required characteristics can be maintained and contamination avoided.

G. Handle masonry units to prevent overstressing, chipping, defacement, and other damage.

1.11 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit repair work to be performed according to product manufacturers' written instructions and specified requirements.

B. Temperature Limits, General: Repair masonry units only when air temperature is between 40 and 90 deg F (4 and 32 deg C) and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.

C. Cold-Weather Requirements: Comply with the following procedures for masonry repair unless otherwise indicated:

1. When air temperature is below 40 deg F (4 deg C), heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg F (4 and 49 deg C).
2. When mean daily air temperature is below 40 deg F (4 deg C), provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for seven days after repair.

D. Hot-Weather Requirements: Protect masonry repair when temperature and humidity conditions produce excessive evaporation of water from mortar and repair materials. Provide artificial shade and wind breaks, and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F (32 deg C) and above unless otherwise indicated.

E. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain each type of material for repairing historic masonry (face brick, cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 OWNER-FURNISHED MATERIAL

A. Salvaged brick.

2.3 MASONRY MATERIALS

A. Face Brick: Provide face brick, including molded, ground, cut, or sawed shapes where required to complete masonry repair work.

1. Brick Matching Existing: Provide units with colors, color variation within units, surface texture, size, and shape to match existing brickwork and with physical properties within 10 percent of those determined from preconstruction testing of selected existing units.

   a. For existing brickwork that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range and variation rather than brick that matches an individual color within that range.

2. Special Shapes:

   a. Provide molded, 100 percent solid shapes for applications where core holes or "frogs" could be exposed to view or weather when in final position, and where shapes produced by sawing would result in sawed surfaces being exposed to view.

   b. Provide specially ground units, shaped to match patterns, for arches and where indicated.

   c. Mechanically chopping or breaking brick, or bonding pieces of brick together by adhesive, are unacceptable procedures for fabricating special shapes.

3. Tolerances as Fabricated: According to tolerance requirements in ASTM C 216, Type FBS.

4. Date Identification: Emboss in the clay body on a concealed, interior surface of each unit in easily read 1/2-inch- (13-mm-) high characters, "MADE Insert year." Manufacturer's name may also be embossed.
B. Building Brick: Provide building brick according to ASTM C 62, of same vertical dimension as face brick, for masonry work concealed from view.
   1. Grade SW where in contact with earth.
   2. Grade SW or Grade MW (exterior walls) Grade SW, Grade MW, or Grade NW (interior walls) for concealed backup.
   3. Date Identification: Emboss in the clay body on a concealed, interior surface of each unit in easily read 1/2-inch- (13-mm-) high characters, "MADE Insert year." Manufacturer's name may also be embossed.

C. Salvaged Brick: Obtain salvaged brick from location shown on Drawings. Clean off residual mortar.

2.4 MORTAR MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or Type II; white or gray or both where required for color matching of mortar.
   1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.


D. Quicklime: ASTM C 5, pulverized lime.

E. Mortar Sand: ASTM C 144 unless otherwise indicated.
   1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
   2. Colored Mortar: Provide natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Davis Colors.
      b. Lanxess Corporation.
      c. Solomon Colors, Inc.

G. Water: Potable.

2.5 MANUFACTURED REPAIR MATERIALS

A. Brick Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching brick masonry.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Use formulation that is vapor and water permeable (equal to or more than the masonry unit), exhibits low shrinkage, has lower modulus of elasticity than the masonry units being repaired, and develops high bond strength to all types of masonry.

3. Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.

4. Formulate patching compound used for patching brick in colors and textures to match each unit being patched. Provide not less than six colors to enable matching the color, texture, and variation of each unit.

2.6 ACCESSORY MATERIALS

A. Masonry Repair Anchors, Expansion Type: Mechanical fasteners designed for masonry veneer stabilization consisting of 1/4-inch- (6-mm-) diameter, Type 304 stainless-steel rod with brass expanding shells at each end and water-shedding washer in the middle. Expanding shells shall be designed to provide positive mechanical anchorage to veneer on one end and backup masonry on the other.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
a. BLOK-LOK Limited.
b. Dur-O-Wal; a Hohmann & Barnard company.
c. Hohmann & Barnard, Inc.

B. Masonry Repair Anchors, Spiral Type: Driven-in, [Type 304] [Type 316] stainless-steel spiral rods designed to be installed in drilled holes and relying on screw effect rather than adhesive to secure them to backup and veneer. Anchors are flexible in plane of veneer but rigid perpendicular to it.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
a. BLOK-LOK Limited.
b. Dur-O-Wal; a Hohmann & Barnard company.
c. Heckmann Building Products, Inc.
d. Hohmann & Barnard, Inc.

C. Masonry Repair Anchors, Rod/Screen Tube Type: Type 304 stainless-steel screen tube with Type 304 stainless-steel rod, adhesive-installed by injection with manufacturer's standard epoxy adhesive, and complete with other devices required for installation.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   
a. Hohmann & Barnard, Inc.

D. Masonry Repair Anchors, Expanding Grout Sleeve Type: Fabric sleeve system with Type 304 stainless-steel tube through which system manufacturer's grout is pumped to expand the sleeve, fill cavities within wall, and bond mechanically and chemically with interior of wall construction; and complete with other devices required for installation.
1. **Manufacturers**: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. CINTEC America Inc.

E. **Setting Buttons and Shims**: Resilient plastic, nonstaining to masonry, sized to suit joint thicknesses and bed depths of masonry units, less the required depth of pointing materials unless removed before pointing.

F. **Masking Tape**: Nonstaining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.

G. **Antirust Coating**: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer according to SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.
   1. Surface Preparation: Use coating requiring no better than SSPC-SP 2, "Hand Tool Cleaning" surface preparation according to manufacturer's literature or certified statement.
   2. VOC Limit: Use coating with a VOC content of 400 g/L (3.3 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

H. **Other Products**: Select materials and methods of use based on the following, subject to approval of a mockup:
   1. Previous effectiveness in performing the work involved.
   2. Minimal possibility of damaging exposed surfaces.
   3. Consistency of each application.
   4. Uniformity of the resulting overall appearance.
   5. Do not use products or tools that could do the following:
      a. Remove, alter, or harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in Contract.
      b. Leave residue on surfaces.

2.7 **MORTAR MIXES**

A. **Preparing Lime Putty**: Slake quicklime and prepare lime putty according to appendix to ASTM C 5 and manufacturer's written instructions.

B. **Measurement and Mixing**: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

C. **Colored Mortar**: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.
   1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

D. **Do not use admixtures in mortar unless otherwise indicated.**

E. **Mortar Mixes**: Mix mortar materials in the following proportions:
1. Pointing Mortar by Property: ASTM C 270, Property Specification, materials mixed to match the historic mortar in color, and texture. The sand must match the sand in the historic mortar. The new mortar must have greater vapor permeability and be softer in compressive strength than the masonry units. The new mortar must be as vapor permeable and as soft or softer than the historic mortar.

PART 3 - EXECUTION

3.1 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.
   1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
   2. Keep wall area wet below rebuilding and pointing work to discourage mortar from adhering.
   3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.

B. Remove gutters and downspouts and associated hardware adjacent to immediate work area, and store during masonry repair work. Reinstall when repairs are complete.
   1. Provide temporary rain drainage during work to direct water away from building.

3.2 MASONRY REPAIR, GENERAL

A. Repair Appearance Standard: Repaired surfaces are to have a uniform appearance as viewed from 20 feet (6 m) away by Architect.

3.3 ABANDONED ANCHOR REMOVAL

A. Remove abandoned anchors, brackets, wood nailers, and other extraneous items no longer in use unless indicated to remain.
   1. Remove items carefully to avoid spalling or cracking masonry.
   2. Notify Architect before proceeding if an item cannot be removed without damaging surrounding masonry. Do the following where directed:
      a. Cut or grind off item approximately 3/4 inch (20 mm) beneath surface, and core drill a recess of same depth in surrounding masonry as close around item as practicable.
      b. Immediately paint exposed end of item with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended dry film thickness per coat. Keep paint off sides of recess.
   3. Patch the hole where each item was removed unless directed to remove and replace the masonry unit.

3.4 BRICK REMOVAL AND REPLACEMENT

A. Remove bricks that are damaged, spalled, or deteriorated or are to be reused. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.
1. When removing single bricks, remove material from center of brick and work toward outside edges.

B. Support and protect remaining masonry that surrounds removal area.

C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.

D. Notify Architect of unforeseen detrimental conditions, including voids, cracks, bulges, loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.

E. Remove in an undamaged condition as many whole bricks as possible.
   1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
   2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
   3. Store brick for reuse. Store off ground, on skids, and protected from weather.
   4. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.

F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.

G. Replace removed damaged brick with other removed brick and salvaged brick in good condition, where possible, or with new brick matching existing brick. Do not use broken units unless they can be cut to usable size.

H. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.
   1. Maintain joint width for replacement units to match existing joints.
   2. Use setting buttons or shims to set units accurately spaced with uniform joints.

I. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. (30 g/194 sq. cm per min.). Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.
   1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
   2. Rake out mortar used for laying brick before mortar sets according to Section 040323 "Historic Brick Unit Masonry Repointing." Point at same time as repointing of surrounding area.
   3. When mortar is sufficiently hard to support units, remove shims and other devices interfering with pointing of joints.

J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
   1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.5 Backup Masonry Removal and Replacement

A. Where backup masonry is fractured or unstable and at locations indicated, remove mortar and masonry units that are broken or deteriorated and rebuild with whole, new brick or whole salvaged units. Carefully remove entire units
from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Support and protect remaining masonry that surrounds removal area.

C. Maintain flashing, reinforcement, anchors, lintels, and adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.

D. Notify Architect of unforeseen detrimental conditions, including voids, cracks, bulges, loose units beyond the removal area, rotted wood, rusted metal, and other deteriorated items.

E. Remove in an undamaged condition as many whole bricks as possible.
   1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
   2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
   3. Store brick for reuse. Store off ground, on skids, and protected from weather.
   4. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.

F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.

G. Replace removed damaged brick with salvaged backup brick in good condition, where possible, or with new building brick matching existing backup brick. Do not use broken units unless they can be cut to usable size.

H. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

I. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. (30 g/194 sq. cm per min.). Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.

J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
   1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.6 PAINTING STEEL UNCOVERED DURING THE WORK

A. Notify Architect if steel is exposed during masonry removal. Where Architect determines that steel is structural, or for other reasons cannot be totally removed, prepare and paint it as follows:
   1. Surface Preparation: Remove paint, rust, and other contaminants according to SSPC-SP 2, "Hand Tool Cleaning", as applicable to comply with paint manufacturer's recommended preparation.
   2. Antirust Coating: Immediately paint exposed steel with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended rate of application (dry film thickness per coat).
B. If on inspection and rust removal, the thickness of a steel member is found to be reduced from rust by more than 1/16 inch (1.6 mm), notify Architect before proceeding.

3.7 MASONRY UNIT PATCHING

A. Patch the following masonry units unless another type of repair or replacement is indicated:
   1. Units indicated to be patched.
   2. Units with holes.
   3. Units with chipped edges or corners. Patch chipped edges or corners measuring more than 3/4 inch (19 mm) in least dimension.
   4. Units with small areas of deep deterioration. Patch deep deteriorations measuring more than 3/4 inch (19 mm) in least dimension and more than 1/4 inch (6 mm) deep.

B. Remove and replace existing patches unless otherwise indicated or approved by Architect.

C. Patching Bricks:
   1. Remove loose material from masonry surface. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 inch (6 mm) thick, but not less than recommended in writing by patching compound manufacturer.
   2. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of masonry unit.
   3. Mix patching compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
   4. Rinse surface to be patched and leave damp, but without standing water.
   5. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
   6. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch (6 mm) or more than 2 inches (50 mm) thick. Roughen surface of each layer to provide a key for next layer.
   7. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the masonry unit. Shape and finish surface before or after curing, as determined by testing, to best match existing masonry unit.
   8. Keep each layer damp for 72 hours or until patching compound has set.

3.8 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.
   1. Do not use metal scrapers or brushes.
   2. Do not use acidic or alkaline cleaners.

B. Clean adjacent nonmasonry surfaces. Use detergent and soft brushes or cloths.

C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

D. Remove masking materials, leaving no residues that could trap dirt.
3.9 FIELD QUALITY CONTROL

A. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

B. Notify testing agency and Architect's Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until Architect's Project representatives have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

3.10 MASONRY-WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property.

B. Masonry Waste: Remove masonry waste and legally dispose of off Owner's property.

END OF SECTION 04 03 22
SECTION 04 03 23 - HISTORIC BRICK UNIT MASONRY REPOINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section includes historic treatment work consisting of repointing brick masonry as follows:
      1. Repointing joints with mortar and sealant.
   B. Related Requirements:
      1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.3 DEFINITIONS
   A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

1.4 PREINSTALLATION MEETINGS
   A. Preinstallation Conference: Conduct conference historic masonry repair and repointing at Project site.
      1. Review minutes of Preliminary Historic Treatment Conference that pertain to masonry historic treatment and repointing.
      2. Review methods and procedures related to repointing historic brick masonry, including, but not limited to, the following:
         a. Historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
         b. Materials, material application, sequencing, tolerances, and required clearances.
         c. Quality-control program.
         d. Fire-protection plan.
         e. Unit masonry historic treatment program.
         f. Coordination with building occupants.

1.5 SEQUENCING AND SCHEDULING
   A. Order sand and gray portland cement for pointing mortar immediately after approval of mockups. Take delivery of and store at Project site a sufficient quantity to complete Project.
B. Work Sequence: Perform masonry historic treatment work in the following sequence, which includes work specified in this and other Sections:

1. Remove plant growth.
2. Inspect masonry for open mortar joints and repair before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
3. Remove paint.
4. Clean masonry.
5. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
6. Repair masonry, including replacing existing masonry with new masonry materials.
7. Rake out mortar from joints to be repointed.
8. Point mortar and sealant joints.
9. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
10. Where water repellents are to be used on or near masonry work, delay application of these chemicals until after pointing and cleaning.

C. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units according to Section 040322 "Historic Brick Unit Masonry Repair." Patch holes in mortar joints according to "Repointing Masonry" Article below.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include recommendations for product application and use. Include test data substantiating that products comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of repointing work on the structure.
2. Show provisions for expansion joints or other sealant joints.
3. Show locations of scaffolding and points of scaffolding in contact with masonry. Include details of contact or anchorage.

C. Samples for Initial Selection: For the following:

1. Pointing Mortar: Submit sets of mortar for pointing in the form of sample mortar strips, 6 inches (150 mm) long by 1/4 inch (6 mm) wide, set in aluminum or plastic channels.
   a. Have each set contain a close color range of at least six Samples of different mixes of colored sands and cements that produce a mortar matching the existing, cleaned mortar when cured and dry.
   b. Submit with precise measurements on ingredients, proportions, gradations, and sources of colored sands from which each Sample was made.

2. Sand Type Used for Pointing Mortar: Minimum 8 oz. (240 mL) of each in plastic screw-top jars.
a. For blended sands, provide Samples of each component and blend. Identify blend ratio.
b. Identify sources, both supplier and quarry, of each type of sand.

4. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For the following:

1. Each type, color, and texture of pointing mortar in the form of sample mortar strips, 6 inches (150 mm) long by 1/4 inch (6 mm) wide, set in aluminum or plastic channels.
   a. Include with each Sample a list of ingredients with proportions of each. Identify sources, both supplier and quarry, of each type of sand and brand names of cementitious materials and pigments if any.

2. Sealant materials.
3. Accessories: Each type of anchor, accessory, and miscellaneous support.

1.7 INFORMATIONAL SUBMITTALS

1.8 Qualification Data: For historic treatment specialists including field supervisors and workers and testing service.

   A. Preconstruction Test Reports: For existing masonry units and mortar.

   B. Quality-control program.

   C. Unit masonry historic treatment program.

1.9 QUALITY ASSURANCE

   A. Historic Treatment Specialist Qualifications: A qualified historic masonry repointing specialist. Experience in pointing or repointing only new or nonhistoric masonry is insufficient experience for masonry historic treatment work.

   B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising worker performance and preventing damage.

   C. Unit Masonry Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for each phase of historic treatment work, including protection of surrounding materials and Project site.

      1. Include methods for keeping pointing mortar damp during curing period.
      2. If materials and methods other than those indicated are proposed for any phase of historic treatment work, add to the quality-control program a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.
D. Mockups: Prepare mockups of historic treatment on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.
   1. Repointing: Rake out joints in two separate areas, each approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide for each type of repointing required, and repoint one of the areas.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on masonry units as follows:
   1. Provide test specimens as indicated and representative of proposed materials and existing construction.
   2. Existing Brick: Test each type of existing brick indicated for repointing, according to testing methods in ASTM C 67 for compressive strength and initial rate of absorption (suction). Carefully remove three existing units from locations designated by Architect. Take testing samples from these units.
   3. Existing Mortar: Test according to ASTM C 295, modified as agreed by testing service and Architect for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength. Use X-ray diffraction, infrared spectroscopy, and differential thermal analysis to supplement microscopical methods. Carefully remove existing mortar from within joints at five locations designated by testing service an approved by architect.
   4. Temporary Patch: As directed by Architect, provide temporary materials at locations from which existing samples were taken.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

D. Store lime putty covered with water in sealed containers.

E. Store sand where grading and other required characteristics can be maintained and contamination avoided.
1.12 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit repointing work to be performed according to product manufacturers' written instructions and specified requirements.

B. Temperature Limits, General: Repoint mortar joints only when air temperature is between 40 and 90 deg F (4 and 32 deg C) and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.

C. Cold-Weather Requirements: Comply with the following procedures for mortar-joint pointing unless otherwise indicated:
   1. When air temperature is below 40 deg F (4 deg C), heat mortar ingredients and existing masonry walls to produce temperatures between 40 and 120 deg F (4 and 49 deg C).
   2. When mean daily air temperature is below 40 deg F (4 deg C), provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for seven days after pointing.

D. Hot-Weather Requirements: Protect mortar-joint pointing when temperature and humidity conditions produce excessive evaporation of water from mortar materials. Provide artificial shade and wind breaks, and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F (32 deg C) and above unless otherwise indicated.

E. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain each type of material for repointing historic masonry (cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C 150/C 150, Type I or Type II; white or gray or both where required for color matching of exposed mortar.
   1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.


D. Quicklime: ASTM C 5, pulverized lime.

E. Mortar Sand: ASTM C 144 unless otherwise indicated.
1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.

2. Color: Provide natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.


1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Davis Colors.
   b. Lanxess Corporation.
   c. Solomon Colors, Inc.

G. Water: Potable.

2.3 ACCESSORY MATERIALS

A. Sealant Materials:

1. Sealant manufacturer's standard elastomeric sealant(s) of base polymer and characteristics indicated below and according to applicable requirements in Section 079200 "Joint Sealants."

   a. Type: one part, fire resistant, ultra-low modulus silicone.

2. Colors: Provide colors of exposed sealants to match colors of mortar adjoining installed sealant unless otherwise indicated.

3. Ground-Mortar Aggregate: Custom crushed and ground pointing mortar sand or existing mortar retrieved from joints. Grind to a particle size that matches the adjacent mortar aggregate and color. Remove all fines passing the 100 sieve.

B. Joint-Sealant Backing:

1. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or Type B (bicellular material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

2. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended in writing by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

C. Masking Tape: Nonstaining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.

D. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

   1. Previous effectiveness in performing the work involved.
   2. Minimal possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could do the following:
   a. Remove, alter, or harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in Contract.
   b. Leave residue on surfaces.

2.4 MORTAR MIXES

   A. Preparing Lime Putty: Slake quicklime and prepare lime putty according to appendix to ASTM C 5 and manufacturer's written instructions.

   B. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

   1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

   C. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

   1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black, which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

   D. Do not use admixtures in mortar unless otherwise indicated.

   E. Mixes: Mix mortar materials in the following proportions:

   1. Pointing Mortar by Property: ASTM C 270, Property Specification, materials mixed to match the historic mortar in color, and texture. The sand must match the sand in the historic mortar. The new mortar must have greater vapor permeability and be softer in compressive strength than the masonry units. The new mortar must be as vapor permeable and as soft or softer than the historic mortar.

PART 3 - EXECUTION

3.1 PROTECTION

   A. Prevent mortar from staining face of surrounding masonry and other surfaces.

   1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
   2. Keep wall area wet below rebuilding and pointing work to discourage mortar from adhering.
   3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.
B. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during masonry repointing work. Reinstall when repointing is complete.
   1. Provide temporary rain drainage during work to direct water away from building.

3.2 MASONRY REPOINTING, GENERAL

A. Appearance Standard: Repointed surfaces are to have a uniform appearance as viewed from 20 feet (6 m) away by Architect.

3.3 REPOINTING MASONRY

A. Rake out and repoint joints to the following extent:
   1. All joints in areas indicated on drawings.
   2. Use sealant at joints only where existing conditions have flexible joints.
   3. Joints at locations of the following defects:
      a. Holes and missing mortar.
      b. Cracks that can be penetrated 1/4 inch (6 mm) or more by a knife blade 0.027 inch (0.7 mm) thick.
      c. Cracks 1/16 inch (1.6 mm) or more in width and of any depth.
      d. Hollow-sounding joints when tapped by metal object.
      e. Eroded surfaces 1/4 inch (6 mm) or more deep.
      f. Deterioration to point that mortar can be easily removed by hand, without tools.
      g. Joints filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:
   1. Remove mortar from joints to depth of 2-1/2 times joint width, but not less than 3/4 inch (20 mm) or not less than that required to expose sound, unweathered mortar. Do not remove unsound mortar more than 2 inches (50 mm) deep; consult Architect for direction.
   2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
   3. Do not spall edges of masonry units or widen joints. Replace or patch damaged masonry units as directed by Architect.
      a. Cut out mortar by hand with chisel and resilient mallet. Do not use power-operated grinders without Architect's written approval based on approved quality-control program.
      b. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Remove remaining mortar in bed joints and mortar in head joints by hand with chisel and resilient mallet. Strictly adhere to approved quality-control program.

D. Notify Architect of unforeseen detrimental conditions, including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.
E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.

2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 1/4 inch until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.

3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 1/4 inch. Fully compact each layer and allow it to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.

4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.

5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
   a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
   b. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.

6. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Remove mortar and repoint.

F. Pointing with Sealant: Comply with Section 079200 “Joint Sealants” and as follows:

1. After raking out, keep joints dry and free of mortar and debris.

2. Clean and prepare joint surfaces. Prime joint surfaces unless sealant manufacturer recommends against priming. Do not allow primer to spill or migrate onto adjoining surfaces.

3. Fill sealant joints with specified joint sealant:
   a. Install cylindrical sealant backing beneath the sealant. Where space is insufficient for cylindrical sealant backing, install bond-breaker tape.
   b. Install sealant using only proven installation techniques that ensure that sealant is deposited in a uniform, continuous ribbon, without gaps or air pockets, and with complete wetting of the joint bond surfaces equally on both sides. Fill joint flush with surrounding masonry and matching the contour of adjoining mortar joints.
   c. Install sealant as recommended in writing by sealant manufacturer but within the following general limitations, measured at the center (thin) section of the bead:
      1) Fill joints to a depth equal to joint width, but not more than 1/2 inch (13 mm) deep or less than 1/4 inch (6 mm) deep.
   d. Tool sealant to form smooth, uniform beads, slightly concave. Remove excess sealant from surfaces adjacent to joint.
   e. Sanded Joints: Immediately after first tooling, apply ground-mortar aggregate to sealant, gently pushing aggregate into the surface of sealant. Lightly retool sealant to form smooth,
uniform beads, slightly concave. Remove excess sealant and aggregate from surfaces adjacent to joint.

f. Do not allow sealant to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces, particularly rough textures. Remove excess and spillage of sealant promptly as the work progresses. Clean adjoining surfaces by the means necessary to eliminate evidence of spillage, without damage to adjoining surfaces or finishes, as demonstrated in an approved mockup.

G. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.4 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

B. Clean adjacent nonmasonry surfaces. Use detergent and soft brushes or cloths.

C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

D. Remove masking materials, leaving no residues that could trap dirt.

3.5 FIELD QUALITY CONTROL

A. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

B. Notify testing agency and Architect's Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until inspectors and Architect's Project representatives have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

END OF SECTION 04 03 23
SECTION 04 03 42 - HISTORIC STONE MASONRY REPAIR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes historic treatment work consisting of repairing historic stone assemblies as follows:

1. Repairing stone masonry, including replacing whole and partial units.
2. Removing abandoned anchors.
3. Painting steel uncovered during the Work.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures."
2. Section 024296 "Historic Removal and Dismantling" for historic removal and dismantling work.
3. Section 076200 "Sheet Metal Flashing and Trim" for metal flashing installed in or on repaired stonework.

1.3 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

B. Face Bedding: Setting of stone with the rift or natural bedding planes (strata) vertical and parallel to the wall plane rather than horizontal or "naturally bedded," which holds bedding planes together by gravity.

C. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

D. Rift: The most pronounced direction of splitting or cleavage of a stone.


1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to stone historic treatment and repair.
2. Review methods and procedures related to repairing historic stone masonry including, but not limited to, the following:
a. Verify historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Materials, material application, sequencing, tolerances, and required clearances.
c. Quality-control program.
d. Fire-protection plan.
e. Stone historic treatment program.
f. Coordination with building occupants.

1.5 SEQUENCING AND SCHEDULING

A. Order sand and gray portland cement for colored mortar immediately after approval of mockups. Take delivery of and store at Project site a sufficient quantity to complete Project.

B. Work Sequence: Perform stone historic treatment work in the following sequence, which includes work specified in this and other Sections:

1. Remove plant growth.
2. Inspect for open mortar joints and repair before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
3. Remove paint.
4. Clean stone.
5. Rake out mortar from joints surrounding stone to be replaced and from joints adjacent to stone repairs along joints.
6. Repair stonework, including replacing existing stone with new stone. If required, repair backup masonry.
7. Rake out mortar from joints to be repointed.
8. Point mortar and sealant joints.
9. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
10. Where water repellents are to be used on or near stonework, delay application of these chemicals until after pointing and cleaning.

C. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in stone according to "Stone Patching" Article. Patch holes in mortar joints according to Section 040343 "Historic Stone Masonry Repointing."

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include recommendations for product application and use. Include test data substantiating that products comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of stone repair work on the structure.
2. Indicate complete dimensions for new stone units and their jointing, showing relation of existing to new units.
3. Show partial replacement stone units (duchmen).
4. Indicate setting number of each new stone unit and its location on the structure in annotated plans and elevations.
5. Show provisions for expansion joints or other sealant joints.
6. Show provisions for flashing, lighting fixtures, conduits, and weep holes as required.
7. Show replacement and repair anchors, including drilled-in pins. Include details of anchors within individual stone units, with locations of anchors and dimensions of holes and recesses in stone required for anchors, including direction and angle of holes for pins.
8. Show locations of scaffolding and points of scaffolding in contact with masonry. Include details of each point of contact or anchorage.

C. Samples for Initial Selection: For the following:

1. Colored Mortar: Submit sets of mortar that will be left exposed in the form of sample mortar strips, 6 inches (150 mm) long by 1/4 inch (6 mm) wide, set in aluminum or plastic channels.
   a. Have each set contain a close color range of at least six Samples of different mixes of colored sands and cements that produce a mortar matching the existing, cleaned mortar when cured and dry.
   b. Submit with precise measurements on ingredients, proportions, gradations, and sources of colored sands from which each Sample was made.

2. Each type of sand used for mortar; minimum 8 oz. (240 mL) of each in plastic screw-top jars.
   a. For blended sands, provide Samples of each component and blend. Identify blend ratio.
   b. Identify sources, both supplier and quarry, of each type of sand.

3. Patching Compound: Submit sets of patching compound Samples in the form of plugs (patches in drilled holes) in sample units of stone representative of the range of stone colors on the building.
   a. Have each set contain a close color range of at least six Samples of different mixes of patching compound that matches the variations in existing stone when cured and dry.

4. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For the following:

1. Each type of replacement stone. Include sets of Samples to show full range of color, texture, grain, veining, and finish to be expected. Provide sets of at least three 12-by-12-inch (300-by-300-mm) Samples for each type, but no fewer than necessary to indicate full range and the proportion of variations within range.
2. Each type of patching compound in form of briquettes, at least 3 inches (75 mm) long by 1-1/2 inches (38 mm) wide. Document each Sample with manufacturer and stock number or other information necessary to order additional material.
3. Each type of adhesive.
4. Accessories: Each type of anchor, accessory, and miscellaneous support.
1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For historic treatment specialists including field supervisors and workers and testing service.

B. Preconstruction Test Reports: For existing stone and mortar and replacement stone.

C. Quality-control program.

D. Stone historic treatment program.

1.8 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic stone repair specialist. Experience installing standard unit masonry or new stone masonry is insufficient experience for stone historic treatment work.

1. Historic Treatment Worker Qualifications: When stone units are being patched, assign at least one worker per crew who is trained and certified by manufacturer of patching compound to apply its products.

B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising worker performance and preventing damage.

C. Stone Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for each phase of the historic treatment work including protection of surrounding materials and Project site.

1. Include methods for keeping exposed mortar damp during curing period.
2. If materials and methods other than those indicated are proposed for any phase of historic treatment work, add to the quality-control program a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.

D. Mockups: Prepare mockups of historic treatment on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Stone Repair: Prepare sample areas for each type of stone indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches (1200 mm) in least dimension. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

a. Replacement: two stone units replaced.

b. Stone Plug Repair: Two stone plug repairs for each type of stone indicated to be plugged.

c. Crack Injection: Apply crack injection in two separate areas, each approximately 36 inches (900 mm) long.

d. Patching: Three small holes at least 1 inch (25 mm) in diameter.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on stone units as follows:

1. Provide test specimens as indicated and representative of proposed materials and existing construction.
2. Replacement Stone: Test each proposed type of replacement stone, according to ASTM C 170/C 170M for compressive strength, wet and dry, perpendicular and parallel to rift; ASTM C 99/C 99M for modulus of rupture, wet and dry, perpendicular and parallel to rift; and ASTM C 97/C 97M for absorption and bulk specific gravity.
3. Existing Stone: Test each type of existing stone indicated for replacement, according to ASTM C 170/C 170M for compressive strength, wet and dry, perpendicular and parallel to rift; ASTM C 99/C 99M for modulus of rupture, wet and dry, perpendicular and parallel to rift; and ASTM C 97/C 97M for absorption and bulk specific gravity. Carefully remove two existing stones from locations designated by Architect. Take testing samples from these stones.
4. Existing Mortar: Test according to ASTM C 295, modified as agreed by testing service and Architect for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength. Use x-ray diffraction, infrared spectroscopy, and differential thermal analysis to supplement microscopical methods. Carefully remove existing mortar from within joints at two locations designated by testing service and approved by Architect.
5. Temporary Patch: As directed by Architect, provide temporary materials followed by permanent repairs at locations from which existing samples were taken.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver stone units to Project site strapped together in suitable packs or pallets or in heavy-duty crates and protected against impact and chipping.
B. Deliver each piece of stone with code mark or setting number on unexposed face, corresponding to Shop Drawings, using nonstaining paint.
C. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.
D. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
E. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.
F. Store lime putty covered with water in sealed containers.
G. Store sand where grading and other required characteristics can be maintained and contamination avoided.

H. Handle stone to prevent overstressing, chipping, defacement, and other damage.

1.11 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit repair work to be performed according to product manufacturers' written instructions and specified requirements.

B. Temperature Limits, General: Repair stone units only when air temperature is between 40 and 90 deg F (4 and 32 deg C) and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.

C. Cold-Weather Requirements: Comply with the following procedures for stone repair unless otherwise indicated:
   1. When air temperature is below 40 deg F (4 deg C), heat mortar ingredients, repair materials, and existing stone to produce temperatures between 40 and 120 deg F (4 and 49 deg C).
   2. When mean daily air temperature is below 40 deg F (4 deg C), provide enclosure and heat to maintain temperatures above 32 deg F (zero deg C) within the enclosure for seven days after repair.

D. Hot-Weather Requirements: Protect stone repair when temperature and humidity conditions produce excessive evaporation of water from mortar and patching materials. Provide artificial shade and wind breaks and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F (32 deg C) and above unless otherwise indicated.

E. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain each type of material for repairing historic masonry (stone, cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 MASONRY MATERIALS

A. Stone Matching Existing: Provide natural building stone of variety, color, texture, grain, veining, finish, size, and shape to match existing stone and with physical properties within 10 percent of those determined from preconstruction testing of selected existing stone.
   1. For existing stone that exhibits a range of colors, textures, grains, veining, finishes, sizes, or shapes, provide stone that proportionally matches that range rather than stone that matches an individual color, texture, grain, veining, finish, size, or shape within that range.
B. Quarrying New Stone: Have quarry clearly label the direction of rift or bedding planes when rough stone is quarried, to facilitate cutting stones so that natural bedding planes are as required in "Cutting New Stone" Paragraph.

C. Cutting New Stone: Regardless of how existing stone was cut and set, cut each new stone so that, when it is set in final position, the rift or natural bedding planes match the rift of existing stones except for arches, where bedding planes are predominantly radial or vertical, but perpendicular to the wall plane.

D. Date Identification: Stamp with permanent, nonbleeding ink on a concealed, interior surface of each new stone in easily read 1/4-inch-(6-mm)-high characters, "MADE Insert year."

E. Salvaged Stone: Obtain from location indicated on Drawings. Clean off residual mortar.

F. Building Brick: Brick having same vertical dimension as existing backup brick, according to ASTM C 62 and Section 040322 "Historic Brick Unit Masonry Repair."

2.3 MORTAR MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or Type II; white or gray, or both, where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.


D. Quicklime: ASTM C 5, pulverized lime.

E. Mortar Sand: ASTM C 144 unless otherwise indicated.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.

2. Colored Mortar: Provide natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

3. For exposed mortar, provide sand with rounded edges.


1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Davis Colors.
   b. Lanxess Corporation.
   c. Solomon Colors, Inc.

G. Water: Potable.
2.4 MANUFACTURED REPAIR MATERIALS

A. Stone Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching stone.

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   
a. **Cathedral Stone Products, Inc.**
b. **Conproco Corporation.**
c. **Edison Coatings, Inc.**
d. **KEIM Mineral Coatings of America.**

2. Use formulation that is vapor and water permeable (equal to or more than the stone), exhibits low shrinkage, has lower modulus of elasticity than the stone units being repaired, and develops high bond strength to all stone types.

3. Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.

4. Formulate patching compound in colors, textures, and grain to match stone being patched. Provide no fewer than three colors to enable matching each piece of stone.

B. Cementitious Crack Filler: An ultrafine superplasticized grout that can be injected into cracks, is suitable for application to wet or dry cracks, exhibits low shrinkage, and develops high bond strength to all stone types.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   
a. **Cathedral Stone Products, Inc.**
b. **Edison Coatings, Inc.**

C. Stone-to-Stone Adhesive: Two-part polyester or epoxy-resin stone adhesive with a 15- to 45-minute cure at 70 deg F (21 deg C), recommended in writing by adhesive manufacturer for type of stone repair indicated, and matching stone color.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   
a. **Akemi North America.**
b. **Bonstone Materials Corporation.**
c. **Edison Coatings, Inc.**

2.5 ACCESSORY MATERIALS

A. Stone Anchors and Pins: Type and size indicated or, if not indicated, to match existing anchors in size and type. Fabricate anchors and pins from Type 304 stainless steel.

B. Setting Buttons and Shims: Resilient plastic, nonstaining to stone, sized to suit joint thicknesses and bed depths of stone units, less the required depth of pointing materials unless removed before pointing.
C. Masking Tape: Nonstaining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.

D. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer according to SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.
   1. Surface Preparation: Use coating requiring no better than SSPC-SP 2, "Hand Tool Cleaning," surface preparation according to manufacturer's literature or certified statement.
   2. VOC Limit: Use coating with a VOC content of 400 g/L (3.3 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:
   1. Previous effectiveness in performing work involved.
   2. Minimal possibility of damaging exposed surfaces.
   3. Consistency of each application.
   4. Uniformity of the resulting overall appearance.
   5. Do not use products or tools that could do the following:
      a. Remove, alter, or harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in contract.
      b. Leave residue on surfaces.

2.6 MORTAR MIXES

A. Preparing Lime Putty: Slake quicklime and prepare lime putty according to appendix in ASTM C 5 and to manufacturer's written instructions.

B. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

C. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.
   1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

D. Do not use admixtures in mortar unless otherwise indicated.

E. Mixes: Mix mortar materials in the following proportions:
   1. Pointing Mortar by Property: ASTM C 270, Property Specification, materials mixed to match the historic mortar in color, and texture. The sand must match the sand in the historic mortar. The new mortar must have greater vapor permeability and be softer in compressive strength than the masonry units. The new mortar must be as vapor permeable and as soft or softer than the historic mortar.
PART 3 - EXECUTION

3.1 HISTORIC TREATMENT SPECIALIST

3.2 PROTECTION

A. Prevent mortar from staining face of surrounding stone and other surfaces.
   1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
   2. Keep wall area wet below rebuilding and pointing work to discourage mortar from adhering.
   3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.

B. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during stone repair work. Reinstall when repairs are complete.
   1. Provide temporary rain drainage during work to direct water away from building.

3.3 STONE REPAIR, GENERAL

A. Repair Appearance Standard: Repaired surfaces are to have a uniform appearance as viewed from 20 feet (6 m) away by Architect.

3.4 ABANDONED ANCHOR REMOVAL

A. Remove abandoned anchors, brackets, wood nailers, and other extraneous items no longer in use unless indicated to remain.
   1. Remove items carefully to avoid spalling or cracking stone.
   2. Notify Architect before proceeding if an item cannot be removed without damaging surrounding stone; do the following where directed:
      a. Cut or grind off item approximately 3/4 inch (20 mm) beneath surface and core drill a recess of same depth in surrounding stone as close around item as practical.
      b. Immediately paint exposed end of item with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended dry film thickness per coat. Keep paint off sides of recess.
   3. Patch the hole where each item was removed unless directed to remove and replace the stone unit.

3.5 STONE REMOVAL AND REPLACEMENT

A. At locations indicated, remove stone that has deteriorated or is damaged beyond repair or is to be reused. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Support and protect remaining masonry that was supported by removed stone.
C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.

D. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, loose units in existing stone or unit masonry backup, rotted wood, rusted metal, and other deteriorated items.

E. Remove in an undamaged condition as many whole stone units as possible.
   1. Remove mortar, loose particles, and soil from stone by cleaning with hand chisels, brushes, and water.
   2. Remove sealants by cutting close to stone with utility knife and cleaning with solvents.
   3. Store stone for reuse. Store off ground, on skids, and protected from weather.
   4. Deliver cleaned stone not required for reuse to Owner unless otherwise indicated.

F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for stone replacement.

G. Replace removed damaged stone with other removed stone and salvaged stone in good condition, where possible, or with new stone matching existing stone. Do not use broken units unless they can be cut to usable size.

H. Rift: Do not allow face bedding of stone. Before setting, inspect to verify that each stone has been cut so that, when it is set in final position, the rift or natural bedding planes are predominantly horizontal except for arches, where bedding planes are predominantly radial or vertical, but perpendicular to the wall. Reject stone with vertical bedding planes except as required for arches, lintels, and copings.

I. Install replacement stone into bonding and coursing pattern of existing stone. If cutting is required, use a motor-driven saw designed to cut stone with clean, sharp, unchipped edges. Finish edges to blend with appearance of edges of existing stone.
   1. Maintain joint width for replacement stone to match existing joints.
   2. Use setting buttons or shims to set stone accurately spaced with uniform joints.

J. Set replacement stone with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter vertical joints for full width before setting and set units in full bed of mortar unless otherwise indicated. Replace existing anchors with new anchors matching existing configuration.
   1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing stonework.
   2. Rake out mortar used for laying stone before mortar sets according to Section 040343 "Historic Stone Masonry Repointing. Point at same time as repointing of surrounding area.
   3. When mortar is sufficiently hard to support units, remove shims and other devices interfering with pointing of joints.

K. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
   1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.
3.6 BACKUP MASONRY REMOVAL AND REPLACEMENT

A. Where backup masonry is fractured or unstable and at locations indicated, remove mortar and masonry units that are broken or deteriorated and rebuild with whole, new brick or whole salvaged units. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Perform backup masonry removal and replacement according to requirements in Section 040322 "Historic Brick Unit Masonry Repair."

C. Support and protect remaining masonry that surrounds removal area.

D. Maintain flashing, reinforcement, anchors, lintels, and adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.

E. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, loose units beyond the removal area, rotted wood, rusted metal, and other deteriorated items.

F. Remove in an undamaged condition as many whole bricks as possible.
   1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
   2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
   3. Store brick for reuse. Store off ground, on skids, and protected from weather.
   4. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.

G. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.

H. Replace removed damaged brick with salvaged backup brick in good condition, where possible, or with new building brick matching existing backup brick. Do not use broken units unless they can be cut to usable size.

I. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

J. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. (30 g/194 sq. cm per min.). Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.

K. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
   1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.
3.7 PAINTING STEEL UNCOVERED DURING THE WORK

A. Notify Architect if steel is exposed during stone removal. Where Architect determines that it is structural, or for other reasons cannot be totally removed, prepare and paint steel as follows:

1. Surface Preparation: Remove paint, rust, and other contaminants according to SSPC-SP 2, "Hand Tool Cleaning," as applicable to comply with paint manufacturer's recommended preparation.
2. Antirust Coating: Immediately paint exposed steel with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended rate of application (dry film thickness per coat).

B. If on inspection and rust removal, the thickness of a steel member is found to be reduced from rust by more than 1/16 inch (1.6 mm), notify Architect before proceeding.

3.8 PARTIAL STONE REPLACEMENT

A. Remove defective portion of existing stone unit (backing stone). Carefully remove defective portion of stone by making vertical and horizontal saw cuts at face of backing stone and removing defective material to depth required for fitting partial replacement (dutchman).

1. Make edges of backing stone at cuts smooth and square to each other and to finished surface; essentially rectangular. Make back of removal area flat and parallel to stone face.
2. Do not overcut at corners and intersections. Hand trim to produce clean sharp corners with no rounding and no damage to existing work to remain.
3. If backing stone becomes further damaged, remove damaged area and enlarge partial replacement as required.

B. Remove mortar from joints that abut area of stone removal to same depth as stone was removed. Remove loose mortar particles and other debris from surfaces to be bonded and surfaces of adjacent stone units that will receive mortar by cleaning with stiff-fiber brush.

C. Cut and trim partial replacement to accurately fit area where material was removed from backing stone. Fabricate to size required to produce joints between partial replacement and backing stone of no more than 1/16 inch (1.6 mm) in width, and to produce joints between partial replacement and other stones that match existing joints between stones. Cut partial replacement so that, when it is set in final position, natural bedding planes match the orientation of bedding planes of the backing stone unless otherwise indicated.

D. Pinning: Before applying adhesive, prepare for mechanical anchorage consisting of 1/4-inch- (6-mm-) diameter, threaded stainless-steel pins set into 1/4-inch- (6-mm-) diameter holes drilled at a 45-degree downward angle through face of partial replacement and into backing stone. Center and space pins between 3 and 5 inches (75 and 125 mm) apart and at least 2 inches (50 mm) from any edge. Insert pins at least 2 inches (50 mm) in backing stone and 2 inches (50 mm) in partial replacement with end countersunk at least 3/4 inch (19 mm) from exposed face of partial replacement.

E. Concealed Pinning: Before applying adhesive, prepare for concealed mechanical anchorage consisting of 1/4-inch- (6-mm-) diameter, threaded stainless-steel pins set into 1/4-inch- (6-mm-) diameter holes drilled into backing stone and into, but not through, the partial replacement. Center and space pins between 3 and 5 inches (75 and 125 mm) apart and at least 2 inches (50 mm) from any edge. Insert pins at least 2...
inches (50 mm) in backing stone and 2 inches (50 mm) in partial replacement, but no closer than 3/4 inch (19 mm) from exposed face of partial replacement.

F. Apply stone-to-stone adhesive according to adhesive manufacturer’s written instructions. Coat bonding surfaces of backing stone and partial replacement, completely filling all crevices and voids.

G. Apply partial replacement while adhesive is still tacky and hold securely in place until adhesive has cured. Use shims, clamps, wedges, or other devices as necessary to align face of partial replacement with face of backing stone.

H. Clean adhesive residue from exposed surfaces and patch chipped areas and exposed drill holes as specified in “Stone Patching” Article.

3.9 STONE PLUG REPAIR

A. Remove cylindrical piece of damaged stone by core-drilling perpendicular to stone surface.

B. Prepare a replacement plug by core-drilling replacement stone. Use a drill sized to produce a core that fits into hole drilled in damaged stone with only minimum gap necessary for adhesive. Cut and install plug so that, when it is set in final position, natural bedding planes match the orientation of bedding planes of the backing stone unless otherwise indicated.

C. Apply stone-to-stone adhesive according to adhesive manufacturer’s written instructions. Coat bonding surfaces of existing stone and plug, completely filling all crevices and voids.

D. Apply plug flush with surrounding stone while adhesive is still tacky and hold securely in place until adhesive has cured.

E. Clean adhesive residue from exposed surfaces.

3.10 STONE-FRAGMENT REPAIR

A. Carefully remove cracked or fallen stone fragment indicated to be repaired. Reuse only stone fragment that is in sound condition.

B. Remove soil, loose particles, mortar, and other debris or foreign material, from fragment surfaces to be bonded and from parent stone where fragment had broken off, by cleaning with stiff-fiber brush.

C. Pinning: Before applying adhesive, prepare for mechanical anchorage consisting of 1/4-inch- (6-mm-) diameter, threaded stainless-steel pins set into 1/4-inch- (6-mm-) diameter holes drilled at a 45-degree downward angle through face of fragment and into parent stone. Center and space pins 3 to 5 inches (75 to 125 mm) apart and at least 2 inches (50 mm) from any edge. Insert pins at least 2 inches (50 mm) in parent stone and 2 inches (50 mm) in fragment with end countersunk at least 3/4 inch (19 mm) from exposed face of fragment.

D. Concealed Pinning: Before applying adhesive, prepare for concealed mechanical anchorage consisting of 1/4-inch- (6-mm-) diameter, threaded stainless-steel pins set into 1/4-inch- (6-mm-) diameter holes drilled into parent stone and into, but not through, the fragment. Center and space pins 3 to 5 inches (75 to 125 mm) apart and at least 2 inches (50 mm) from any edge. Insert pins at least 2 inches (50 mm) in parent...
stone and 2 inches (50 mm) in fragment, but no closer than 3/4 inch (19 mm) from exposed face of fragment.

E. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of fragment and parent stone, completely filling all crevices and voids.

F. Fit stone fragment onto parent stone while adhesive is still tacky and hold fragment securely in place until adhesive has cured. Use shims, clamps, wedges, or other devices as necessary to align face of fragment with face of parent stone.

G. Clean adhesive residue from exposed surfaces and patch chipped areas and exposed drill holes as specified in "Stone Patching" Article.

3.11 CRACK INJECTION

A. General: Comply with cementitious crack-filler manufacturer's written instructions.

B. Drill 1/4-inch- (6-mm-) diameter injection holes as follows:

1. Transverse Cracks Less Than 3/8 inch (9 mm) Wide: Drill holes through center of crack at 12 to 18 inches (300 to 500 mm) o.c.
2. Transverse Cracks More Than 3/8 inch (9 mm) Wide: Drill holes through center of crack at 18 to 36 inches (500 to 900 mm) o.c.
3. Delaminations: Drill holes at approximately 18 inches (500 mm) o.c., both vertically and horizontally.
4. Drill holes 2 inches (50 mm) deep.

C. Clean out drill holes and cracks with compressed air and water. Remove dirt and organic matter, loose material, sealants, and failed crack repair materials.

D. Place plastic injection ports in drilled holes and seal face of cracks between injection ports with clay or other nonstaining, removable plugging material. Leave openings at upper ends of cracks for air release.

E. Inject cementitious crack filler through ports sequentially, beginning at one end of area and working to opposite end; where possible, begin at lower end of injection area and work upward. Inject filler until it extrudes from adjacent ports. After port has been injected, plug with clay or other suitable material and begin injecting filler at adjacent port, repeating process until all ports have been injected.

F. Clean cementitious crack filler from face of stone before it sets by scrubbing with water.

G. After cementitious crack filler has set, remove injection ports, plugging material, and excess filler. Patch injection holes and surface of cracks as specified in "Stone Patching" Article.

3.12 STONE PATCHING

A. Patch the following stone units unless another type of repair or replacement is indicated:

1. Units indicated to be patched.
2. Units with holes.
3. Units with chipped edges or corners. Patch chipped edges or corners measuring over 3/4 inch (19 mm) in least dimension.

4. Units with small areas of deep deterioration. Patch deep deteriorations measuring over 3/4 inch (19 mm) in least dimension and over 1/4 inch (6 mm) deep.

B. Remove and replace existing patches unless otherwise indicated or approved by Architect.

C. Remove deteriorated material and remove adjacent material that has begun to deteriorate. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 inch (6 mm) thick, but not less than as recommended in writing by patching compound manufacturer.

D. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of stone unit.

E. Mix patching compound in individual batches to match each stone unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.

F. Brush-coat stone surfaces with slurry coat of patching compound according to manufacturer’s written instructions.

G. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch (6 mm) or more than 2 inches (50 mm) thick. Roughen surface of each layer to provide a key for next layer.

1. Simple Details: Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the stone. Shape and finish surface before or after curing, as determined by testing, to best match existing stone.

2. Carved Details: Build patch up 1/4 inch (6 mm) above surrounding stone and carve surface to match adjoining stone after patching compound has hardened.

H. Keep each layer damp for 72 hours or until patching compound has set.

I. Remove and replace patches with hairline cracks or that show separation from stone at edges, and those that do not match adjoining stone in color or texture.

3.13 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed stone surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.

1. Do not use metal scrapers or brushes.

2. Do not use acidic or alkaline cleaners.

B. Clean adjacent nonstone surfaces. Use detergent and soft brushes or cloths.

C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

D. Remove masking materials, leaving no residues that could trap dirt.
E. Sweep and rake adjacent pavement and grounds to remove mortar and debris. Where necessary, pressure wash pavement surfaces to remove mortar, dust, dirt, and stains.

3.14 FIELD QUALITY CONTROL

A. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

B. Notify Architect's Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until Architect's Project representatives have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

3.15 STONE-WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess stone materials are Contractor's property.

B. Stone Waste: Remove stone waste and legally dispose of off Owner's property.

END OF SECTION 04 03 42
SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Clay Masonry Units in new construction (not repair)
   2. Mortar and grout in new construction (not repair)
   3. Steel reinforcing bars.
   5. Ties and anchors.
   6. Embedded flashing.
   7. Miscellaneous masonry accessories.

B. Products Installed but not Furnished under This Section:
   1. Steel lintels in unit masonry.
   2. Steel shelf angles for supporting unit masonry.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:
   1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
   2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars.
      Comply with ACI 315
   3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type and color of the following:
   1. Clay Masonry Units
   2. Weep holes and cavity vents
   3. Accessories embedded in masonry.

1.3 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
   1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
B. Qualification Data: For testing agency.

C. Material Certificates: For each type and size of the following:
   1. Masonry units.
      a. Include data on material properties and material test reports substantiating compliance with requirements.
      b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
      c. For exposed brick, include test report for efflorescence according to ASTM C 67.
      d. For surface-coated brick, include test report for durability of surface appearance after 50 cycles of freezing and thawing according to ASTM C 67 or a list of addresses of buildings in Project's area where proposed brick has been used successfully and with a history of durability.
      e. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
   2. Cementitious materials. Include name of manufacturer, brand name, and type.
   3. Mortar admixtures.
   4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
   5. Grout mixes. Include description of type and proportions of ingredients.
   6. Reinforcing bars.
   7. Joint reinforcement.
   8. Anchors, ties, and metal accessories.

D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
   2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 01 40 00 "Quality Requirements" for mockups.
   1. Build sample panels for each type of exposed unit masonry construction and typical exterior and interior walls in sizes approximately 48 inches long by 48 inches] high by full thickness.
2. Build sample panels facing south.
3. Where masonry is to match existing, build panels adjacent and parallel to existing surface.
4. Clean exposed faces of panels with masonry cleaner indicated.
5. Protect approved sample panels from the elements with weather-resistant membrane.
6. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
   a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
1. Build mockups for each type of exposed unit masonry construction in sizes approximately 48 inches long by 72 inches high by full thickness, including face and backup wythes and accessories.
   a. Include a sealant-filled joint at least 16 inches long in each exterior wall mockup.
   b. Include lower corner of window opening, at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
   c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
   d. Include metal studs, sheathing, water-resistant barrier sheathing joint-and-penetration treatment, air barrier, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.
2. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
3. Clean exposed faces of mockups with masonry cleaner as indicated.
4. Protect accepted mockups from the elements with weather-resistant membrane.
5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
   a. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
1.6 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
   2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe, and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.


PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
2.2 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
   1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

2.4 BRICK

A. Approved Manufacturers:
   1. Basis of Design: Brick to match color and surface of brick on site. Architect to confirm final selection on site. Submit product data and samples for prior approval during bidding phase. Provide product by one of the following manufacturers:
      a. General Shale – Basis of Design Virginia Vintage Tudor
      b. Acme Brick
      c. Boral Bricks

B. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
   1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
   2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
   3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
   4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

C. Clay Masonry Unit: ASTM C 652, Grade SW, Type FBS.
   1. Size: Match size of existing brick on site. Architect to confirm final selection on site.
   2. Application: Use where brick is indicated for concealed locations. Face brick complying with requirements for grade, compressive strength, and size indicated for building brick may be substituted for building brick.
2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
   1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91/C 91M.
   1. Manufacturers which may produce products complying with specifications include:
      a. Essroc
      b. LaFarge
      c. Cemex
      d. Holcim

E. Mortar Cement: ASTM C 1329/C 1329M.
   1. Manufacturers which may produce products complying with specifications include:
      a. Essroc
      b. LaFarge
      c. Cemex
      d. Holcim

F. Aggregate for Mortar: ASTM C 144.
   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
   2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
   3. White-Mortar Aggregates: Natural white sand or crushed white stone.
   4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.


H. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.
UNIT MASONRY

2. Wire Size for Side Rods: 0.187-inch diameter.
5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet with prefabricated corner and tee units.

D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder or truss type with single pair of side rods.

2.7 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
   2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
   4. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.
   5. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
   1. T-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units.
   2. Where wythes do not align or are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.

D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
   1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel or stainless-steel wire.
   2. Tie Section: Triangular-shaped wire tie made from 0.25-inch-diameter, hot-dip galvanized steel or stainless-steel wire.

E. Partition Top Anchors: 0.105-inch-thick metal plate with a 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
   1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.
G. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
2. Fabricate sheet metal anchor sections and other sheet metal parts from **0.105-inch-thick steel sheet, galvanized after fabrication**
3. Fabricate wire ties from **0.25-inch-diameter, hot-dip galvanized-steel** wire unless otherwise indicated.
4. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
5. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section with screw holes top and bottom, with a projecting vertical tab having a slotted hole for inserting wire tie.
   a. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) FERO Corporation.
      2) Hohmann & Barnard, Inc.
6. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section with screw holes top and bottom, with projecting tabs having holes for inserting vertical legs of wire tie formed to fit anchor section.
   a. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) Heckmann Building Products, Inc.
      2) Hohmann & Barnard, Inc.
      3) Wire-Bond.
7. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a sheet metal anchor section, 1-1/4 inches wide by 9 inches long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch wide by 5-1/2 inches long, stamped into center to provide a slot between strap and base for inserting wire tie.
   a. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) Hohmann & Barnard, Inc.
8. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a sheet metal anchor section, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch wide by 3-5/8 inches long, stamped into center to provide a slot between strap and base for inserting wire tie.
   a. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) Heckmann Building Products, Inc.
      2) Hohmann & Barnard, Inc.
      3) Wire-Bond.
9. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a gasketed sheet metal anchor section, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch wide by 6 inches long, stamped into center to provide a slot between strap and base for inserting wire tie. Self-adhering, modified bituminous gasket fits behind anchor plate and extends beyond pronged legs.
a. **Manufacturers**: Subject to compliance with requirements, provide products by one of the following:
   1) Hohmann & Barnard, Inc.
   2) Wire-Bond.

10. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed washer head that covers hole in sheathing.
   a. **Manufacturers**: Subject to compliance with requirements, provide products by one of the following:
      1) Heckmann Building Products, Inc.
      2) Hohmann & Barnard, Inc.
      3) Wire-Bond.

11. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours according to ASTM B 117.

12. Stainless-Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads; either made from Type 410 stainless steel or made with a carbon-steel drill point and 300 Series stainless-steel shank.

### 2.8 EMBEDDED FLASHING MATERIALS

**A. Metal Flashing**: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. **Stainless Steel**: ASTM A 240/A 240M or ASTM A 666, Type 304, 0.016 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
4. Fabricate through-wall flashing with drip edge **where** indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and **hemmed**.
5. Fabricate through-wall flashing with sealant stop **unless** otherwise indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
6. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and **hemmed**.
7. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
8. Fabricate metal expansion-joint strips from **stainless steel** to shapes indicated.
9. Solder metal items at corners.

**B. Flexible Flashing**: Use the following unless otherwise indicated:

1. **EPDM Flashing**: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637/D 4637M, 0.040 inch (1.02 mm) thick.
a. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) Carlisle Coatings & Waterproofing Inc.
2) Firestone Specialty Products.
3) Hohmann & Barnard, Inc.

C. **Application:** Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
4. Where flashing is fully concealed, use metal flashing.

D. **Solder and Sealants for Sheet Metal Flashings:**

1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
2. Elastomeric Sealant: ASTM C 920, chemically curing silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.

E. **Adhesives, Primers, and Seam Tapes for Flashings:** Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.9 **MISCELLANEOUS MASONRY ACCESSORIES**

A. **Preformed Control-Joint Gaskets:** Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

B. **Bond-Breaker Strips:** Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

C. **Weep/Cavity Vent Products:** Use the following unless otherwise indicated:

1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.

   a. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   1) Advanced Building Products Inc.
   2) CavClear/Archovations, Inc.
   3) Keene Building Products.
   4) Mortar Net Solutions.
D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
   1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Advanced Building Products Inc.
      b. CavClear/Archovations, Inc.
      c. Heckmann Building Products, Inc.
      d. Hohmann & Barnard, Inc.
      e. Mortar Net Solutions.
      f. Wire-Bond.

2.10 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
   1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      b. EaCo Chem, Inc.
      c. PROSOCO, Inc.

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.
   2. Use masonry cement or mortar unless otherwise indicated.
   3. For masonry below grade or in contact with earth, use Type M.
   4. For reinforced masonry, use Type S.
   5. For mortar parge coats, use Type S.
   6. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.

B. Grout for Unit Masonry: Comply with ASTM C 476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
   2. Proportion grout in accordance with ASTM C 476.
   3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.
   4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:
1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:
1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 3/32 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:
1. For bed joints, do not vary from thickness indicated by more than plus or minus 3/32 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

H. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
   1. Install compressible filler in joint between top of partition and underside of structure above.
   2. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 84 43 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

A. Lay clay masonry units and CMUs as follows:
   1. Bed face shells in mortar and make head joints of depth equal to bed joints.
   2. Bed webs in mortar in all courses of piers, columns, and pilasters.
   3. Bed webs in mortar in grouted masonry, including starting course on footings.
   4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
   5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. Lay solid masonry units and clay masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Lay structural clay tile as follows:
   1. Lay vertical-cell units with full head joints unless otherwise indicated. Provide bed joints with full mortar coverage on face shells and webs.
   2. Lay horizontal-cell units with full bed joints unless otherwise indicated. Keep drainage channels, if any, free of mortar. Form head joints with sufficient mortar so excess will be squeezed out as units are placed in position. Butter both sides of units to be placed, or butter one side of unit already in place and one side of unit to be placed.
   3. Maintain joint thicknesses indicated except for minor variations required to maintain bond alignment. If not indicated, lay walls with 1/4- to 3/8-inch-thick joints.
D. Set firebox brick in full bed of refractory mortar with full head joints. Form joints by buttering both surfaces of adjoining brick and sliding it into place. Make joints just wide enough to accommodate variations in size of brick, approximately 1/8 inch. Tool joints smooth on surfaces exposed to fire or smoke.

E. Install clay flue liners to comply with ASTM C 1283. Install flue liners ahead of surrounding masonry. Set clay flue liners in full bed of refractory mortar 1/16 to 1/8 inch thick. Strike joints flush on inside of flue to provide smooth surface. Maintain expansion space between flue liner and surrounding masonry except where surrounding masonry is required to provide lateral support for flue liners.

F. Set trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
   1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
   2. Wet joint surfaces thoroughly before applying mortar.
   3. Rake out mortar joints for pointing with sealant.

G. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

H. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

I. Cut joints flush where indicated to receive waterproofing, cavity wall insulation, and/or air barriers unless otherwise indicated.

3.6 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
   1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
   2. Embed connector sections and continuous wire in masonry joints.
   3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
   4. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

B. Provide not less than 1.5 inches of airspace between back of masonry veneer and face of sheathing / insulation (outer face)
   1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.7 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.8 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
1. Provide an open space not less than 1.5 inches wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.9 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:
1. Install preformed control-joint gaskets designed to fit standard sash block.
2. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick as follows:
1. Provide vertical control joints to subdivide brick into areas recommended by the Brick Industry Association Tech Notes. Coordinate locations in field with architect prior to installation unless already indicated on drawings. Control joints shall be installed at all inside brick corners.
2. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
3. Build flanges of factory-fabricated, expansion-joint units into masonry.
4. Build in compressible joint fillers where indicated.
5. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 07 92 00 "Joint Sealants."
D. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 "Joint Sealants," but not less than \(3/8\) inch.
   1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.10 LINTELS

A. Install steel lintels where indicated.

B. Provide concrete or masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

D. Refer to 05 50 00 Metal Fabrications for additional requirements.

3.11 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:
   1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, or tape as recommended by flashing manufacturer.
   2. Provide stainless steel counter flashing below flexible through-wall flashing at all heads of windows and sills of penthouse windows only.
   3. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 14 inches, and 1-1/2 inches into the inner wythe. Form 1/4-inch hook in edge of flashing embedded in inner wythe.
   4. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 14 inches; with upper edge tucked under water-resistant barrier / air barrier, lapping at least 4 inches. Fasten upper edge of flexible flashing to sheathing through termination bar.
   5. At lintels and shelf angles, extend flashing a minimum of 14 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
   6. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
   7. At locations above openings, install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/8 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
   8. No through-wall flashings shall be cut off to fall within a brick core hole.
9. Through-wall flashings shall be run continuous through control joints. Provide for expansion by lapping sections a minimum of 6 inches and seal with 3 rows of sealant, one at each side and one in the middle of the lap. Provide for expansion at wall joints and at every 20 feet.

10. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
   1. Use specified weep/cavity vent products to form head joint weeps.
   2. Space weeps 24 inches o.c. unless otherwise indicated.

E. Place cavity drainage material in cavities and airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

F. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products at open-head joints to form cavity vents.
   1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.12 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
   1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   2. Limit height of vertical grout pours to not more than 60 inches.

3.13 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5 as required by applicable building codes and standards.
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

I. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.14 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.15 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
   6. Clean stone trim to comply with stone supplier's written instructions.
   7. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.16 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 4 inches in each dimension.
   2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 31 20 00 "Earth Moving."
   3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 20 00
SECTION 04 22 00 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section Includes:
      1. Concrete masonry units.
      2. Mortar and grout.
      3. Steel reinforcing bars.
      5. Embedded flashing.
      6. Miscellaneous masonry accessories.
   B. Products Installed but not Furnished under This Section:
   C. Related Requirements:
      1. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
      2. Section 071900 "Water Repellents" for water repellents applied to unit masonry assemblies.
      3. Section 076200 "Sheet Metal Flashing and Trim" for sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 DEFINITIONS
   A. CMU(s): Concrete masonry unit(s).
   B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PREINSTALLATION MEETINGS
   A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS
   A. Product Data: For each type of product.
B. Sustainable Design Submittals:
   1. **Product Certificates**: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.

C. Shop Drawings: For the following:
   1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
   2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
   3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

D. Samples for Initial Selection:
   1. Colored mortar.
   2. Weep holes/vents.

E. Samples for Verification: For each type and color of the following:
   1. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:
   1. Masonry units.
      a. Include data on material properties, and material test reports substantiating compliance with requirements.
      b. For masonry units, include data and calculations establishing average net-area compressive strength of units.
   2. Integral water repellant used in CMUs.
   3. Cementitious materials. Include name of manufacturer, brand name, and type.
   5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
   6. Grout mixes. Include description of type and proportions of ingredients.
   7. Reinforcing bars.
   8. Joint reinforcement.
   9. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
   2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

   1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.


PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.
2.4 CONCRETE MASONRY UNITS

A. Regional Materials: CMUs shall be manufactured within 500 miles (800 km) of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Regional Materials: CMUs shall be manufactured within 500 miles (800 km) of Project site.

C. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
   1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
   2. Provide bullnose units for outside corners unless otherwise indicated.

D. CMUs: ASTM C 90.
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi (19.3 MPa).
   2. Density Classification: Normal weight.

E. Concrete Building Brick: ASTM C 55.
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi (19.3 MPa).
   2. Density Classification: Normal weight.
   3. Size (Actual Dimensions): 3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long.
   4. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi (19.3 MPa).
   5. Density Classification: normal weight.

2.5 CONCRETE AND MASONRY LINTELS

A. General: Provide one of the following:

B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.

C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 033000 "Cast-in-Place Concrete," and with reinforcing bars indicated.

D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.
2.6 MORTAR AND GROUT MATERIALS

A. Regional Materials: Aggregate for mortar and grout, cement, and lime shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Regional Materials: Aggregate for mortar and grout, cement, and lime shall be manufactured within 500 miles (800 km) of Project site.

C. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
   1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.

D. Hydrated Lime: ASTM C 207, Type S.

E. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

F. Masonry Cement: ASTM C 91/C 91M.
   1. Double click here to find, evaluate, and insert list of manufacturers and products.

G. Mortar Cement: ASTM C 1329/C 1329M.
   1. Double click here to find, evaluate, and insert list of manufacturers and products.

H. Aggregate for Mortar: ASTM C 144.
   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
   2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
   3. White-Mortar Aggregates: Natural white sand or crushed white stone.
   4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

I. Aggregate for Grout: ASTM C 404.

J. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
   1. Double click here to find, evaluate, and insert list of manufacturers and products.

K. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
   1. Double click here to find, evaluate, and insert list of manufacturers and products.

L. Water: Potable.
2.7 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

1. [Double click here to find, evaluate, and insert list of manufacturers and products.]

C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.187-inch (4.76-mm) diameter.
4. Wire Size for Cross Rods: 0.187-inch (4.76-mm) diameter.
5. Spacing of Cross Rods: Not more than 16 inches (407 mm) o.c.
6. Provide in lengths of not less than 10 feet (3 m).

2.8 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches (38 mm) into masonry but with at least a 5/8-inch (16-mm) cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

4. Galvanized-Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 (i.e. 180) zinc coating.
5. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTMA 153/A 153M, Class B coating.
6. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.
7. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, stainless-steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
2. Tie Section: Triangular-shaped wire tie made from 0.25-inch- (6.35-mm-) diameter, stainless-steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed 0.105-inch- (2.66-mm-) thick steel sheet, galvanized after fabrication 0.062-inch- (1.59-mm-) thick, stainless-steel sheet.
   a. 0.108-inch- (2.74-mm-) thick, galvanized-steel sheet may be used at interior walls unless otherwise indicated.

2. Tie Section: Triangular-shaped wire tie made from 0.25-inch- (6.35-mm-) diameter, stainless-steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

E. Partition Top Anchors: 0.105-inch- (2.66-mm-) thick metal plate with a 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.35 mm) thick by 24 inches (610 mm) long, with ends turned up 2 inches (51 mm) or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M

2.9 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and Section 076200 "Sheet Metal Flashing and Trim" and as follows:

1. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304, 0.016 inch (0.40 mm) thick.
2. Copper: ASTM B 370, Temper H00, cold-rolled copper sheet, 16-oz./sq. ft. (4.9-kg/sq. m) weight or 0.0216 inch (0.55 mm) thick or ASTM B 370, Temper H01, high-yield copper sheet, 12-oz./sq. ft. (3.7-kg/sq. m) weight or 0.0162 inch (0.41 mm) thick.
3. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.

4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
5. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
6. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch (19 mm) at exterior face of wall and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
7. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches (76 mm) into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam sheds water.
8. Fabricate metal drip edges from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
9. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
10. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
11. Solder metal items at corners.
B. Flexible Flashing: Use the following unless otherwise indicated:

1. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637/D 4637M, 0.040 inch (1.02 mm) thick.

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

      1) Carlisle Coatings & Waterproofing Inc.
      2) Firestone Specialty Products.
      3) Hohmann & Barnard, Inc.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge with a sealant stop or flexible flashing with a metal drip edge.
4. Where flashing is fully concealed, use flexible flashing.

D. Solder and Sealants for Sheet Metal Flashings:

1. Solder for Stainless Steel: ASTM B 32, with acid flux of type recommended by stainless-steel sheet manufacturer.
2. Solder for Copper: ASTM B 32, Grade Sn50 with maximum lead content of 0.2 percent.
3. Elastomeric Sealant: ASTM C 920, chemically curing polysulfide or silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight. (verify compatibility).

E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or urethane.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).
2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime mortar.
4. For reinforced masonry, use portland cement-lime mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S.
3. For mortar parge coats, use Type S.
4. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
3. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that would impair mortar bond.
B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).

2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).

3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.

2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.

3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.

4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.

5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.

6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.

7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm).

C. Joints:
1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Concealed and Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

G. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

H. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.
3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 “Joint Firestopping.”
3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
   1. Bed face shells in mortar and make head joints of depth equal to bed joints.
   2. Bed webs in mortar in all courses of piers, columns, and pilasters.
   3. Bed webs in mortar in grouted masonry, including starting course on footings.
   4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

E. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
   1. Space reinforcement not more than 16 inches (406 mm) o.c.
   2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings [in addition to continuous reinforcement].

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
   1. Provide an open space not less than 1 inch (25 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
   2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
   3. Space anchors as indicated, but not more than 16 inches o.c. vertically and 24 inches (915 mm) o.c. horizontally.
3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:
   1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
   2. Install preformed control-joint gaskets designed to fit standard sash block.
   3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
   4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant. Control joints to be spaced at 20 feet on center (max) and at corners and openings as shown on elevations.

3.9 LINTELS

A. Provide concrete or masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 16 inches for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.10 FLASHING

A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.

B. Install flashing as follows unless otherwise indicated:
   1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
   2. At lintels, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
   3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
   4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
   1. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
3.11 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
   1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Contractor shall engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
I. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.13 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.14 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
   2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
   3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 22 00
SECTION 04 42 00 – LIMESTONE WALL CAPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
1. Limestone wall caps on site walls as shown on Drawings.

B. Related Requirements:
1. Section 042000 "Unit Masonry".
2. Section 079200 "Joint Sealants" for sealing joints in stone cladding system with elastomeric sealants.

1.3 DEFINITIONS
A. Definitions contained in ASTM C 119 apply to this Section.

1.4 ACTION SUBMITTALS
A. Product Data: For each variety of stone, stone accessory, and manufactured product.
B. Shop Drawings: Show fabrication and installation details for stone cladding assembly, including dimensions and profiles of stone units.
   1. Show locations and details of joints both within stone cladding assembly and between stone cladding assembly and other construction.
   2. Include details of mortar joints, sealant joints, and mortar joints pointed with sealant.
   3. Show locations and details of anchors.
   4. Show direction of veining, grain, or other directional pattern.
C. Samples for Initial Selection: For joint materials involving color selection.
D. Stone Samples for Verification: Sets for each variety, color, and finish of stone required; not less than 12 inches (300 mm) square.
   1. Sets shall consist of at least three Samples, exhibiting extremes of the full range of color and other visual characteristics expected and will establish the standard by which stone will be judged.
E. Colored Pointing Mortar Samples for Verification: For each color required. Make Samples using same sand and mortar ingredients to be used on Project.

F. Sealant Samples for Verification: For each type and color of joint sealant required.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Test Reports:

1. Stone Test Reports: For stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous five years.

2. For metal components, by a qualified testing agency, indicating chemical and physical properties of metal.

3. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer complying with requirements in Section 079200 "Joint Sealants" and indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.

C. Source quality-control reports.

D. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate stone cladding assemblies similar to that required for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: A firm or individual experienced in installing stone cladding assemblies similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance.

C. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
1.7 DELIVERY, STORAGE, AND HANDLING

A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.

1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
2. Store stone on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.

B. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical panels so that they are right side up when units are installed.

C. Deliver sealants to Project site in original unopened containers labeled with manufacturer’s name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.

D. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

E. Store aggregates in locations where grading and other required characteristics can be maintained and where contamination can be avoided.

1.8 FIELD CONDITIONS

A. Protect stone cladding during erection by doing the following:

1. Cover tops of stone cladding installation with nonstaining, waterproof sheeting at end of each day’s work. Cover partially completed structures when work is not in progress. Extend cover a minimum of 24 inches (600 mm) down both sides and hold securely in place.
2. Prevent staining of stone from mortar, grout, sealants, and other sources. Immediately remove such materials without damaging stone.
3. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.
4. Protect sills, ledges, and projections from mortar and sealant droppings.

B. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace stone cladding damaged by frost or freezing conditions. Comply with cold-weather construction and protection requirements for masonry contained in TMS 602/ACI 530.1/ASCE 6.


D. Environmental Limitations for Sealants: Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or below 40 deg F (5 deg C) or when joint substrates are wet.
1.9 Coordination

A. Coordinate installation of inserts that are to be embedded in concrete or masonry, flashing reglets, and similar items to be used by stone cladding installer for anchoring, supporting, and flashing of stone cladding assembly. Furnish setting drawings, templates, and directions for installing such items and deliver to Project site in time for installation.

B. Time delivery and installation of stone cladding to avoid extended on-site storage and to coordinate with work adjacent to stone cladding.

Part 2 - Products

2.1 Manufacturers

A. Source Limitations for Stone: Obtain stone from single quarry with resources to provide materials of consistent quality in appearance and physical properties.
   1. For stone types that include same list of varieties and sources, provide same variety from same source for each.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of uniform quality for each cementitious component from single manufacturer and each aggregate from single source or producer.

C. Source Limitations for Other Materials: Obtain each type of stone accessory and other material from single manufacturer for each product.

2.2 Performance Requirements

A. General: Design stone anchors and anchoring systems according to ASTM C 1242.
   1. Stone anchors shall withstand not less than two times the weight of the stone cladding in both compression and tension.

B. Structural Performance: Stone cladding assembly shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Wind Loads: As indicated.
   2. Equipment Loads: Allow for loads due to window cleaning and maintenance equipment.

C. Seismic Performance: Stone cladding assembly shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. Component Importance Factor: 1.0.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
E. Horizontal Building Movement (Interstory Drift): Allow for maximum horizontal building movement equal to quotient resulting from dividing floor-to-floor height at any floor by 400.

F. Safety Factors for Stone: Design stone cladding assembly to withstand loads indicated without exceeding stone's allowable working stress determined by dividing stone's average ultimate strength, as established by testing, by the following safety factors:

G. Design stone anchors to withstand loads indicated without exceeding allowable working stresses established by the following:
   1. For Structural Steel: AISC 360.
   2. For Cold-Formed Steel: AISI's "North American Specification and Commentary for the Design of Cold-Formed Steel Structural Members."
   3. For Cold-Formed Stainless Steel: ASCE/SEI 8, "Specification for the Design of Cold-Formed Stainless Steel Structural Members."
   5. For Cast-in-Place and Postinstalled Fasteners in Concrete: One-fourth of tested capacity when installed in concrete with compressive strength indicated.
   6. For Postinstalled Fasteners in Masonry: One-sixth of tested capacity when installed in masonry units indicated.

H. Corrosion and Staining Control: Prevent galvanic and other forms of corrosion as well as staining by isolating metals and other materials from direct contact with incompatible materials. Materials shall not stain exposed surfaces of stone and joint materials.

2.3 LIMESTONE

A. Material Standard: Comply with ASTM C 568/C 568M.

B. Description: Oolitic limestone.

C. Varieties and Sources: Indiana limestone quarried in Lawrence, Monroe, or Owen Counties, Indiana.
   1. Indiana Limestone Grade and Color: Standard, buff, according to grade and color classification established by ILI.

D. Cut stone from one block or contiguous, matched blocks in which natural markings occur.

E. Finish: Smooth finish.

F. Thickness: As shown on Drawings.

2.4 ANCHORS AND FASTENERS

A. Fabricate anchors from stainless steel, ASTM A 240/A 240M or ASTM A 666, Type 304; temper as required to support loads imposed without exceeding allowable design stresses. Fabricate dowels and pins for anchors from stainless steel, ASTM A 276, Type 304.
B. Fabricate shelf angles for limestone from hot-dip galvanized steel, ASTM A 36/A 36M for materials and ASTM A 123/A 123M for galvanizing.

C. Cast-in-Place Concrete Inserts: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel, with capability to sustain, without failure, a load equal to 4 times the loads imposed as determined by testing per ASTM E 488/E 488M, conducted by a qualified independent testing agency. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

D. Postinstalled Anchor Bolts for Concrete and Masonry: Chemical anchors, torque-controlled expansion anchors or undercut anchors made from stainless-steel components complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Alloy Group A1 or A4) for bolts and nuts; ASTM A 240/A 240M, ASTM A 276, or ASTM A 666, Type 304 or 316, for anchors, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488/E 488M, conducted by a qualified independent testing agency.

E. Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers.

1. For stainless steel and aluminum, use annealed stainless-steel bolts, nuts, and washers; for bolts, ASTM F 593 (ASTM F 738M); and for nuts, ASTM F 594 (ASTM F 836M), Alloy Group 1 (A1).

F. Weld Plates for Installation in Concrete: Comply with Section 055000 "Metal Fabrications."

2.5 MORTAR MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or Type II, except Type III may be used for cold-weather construction, natural color or white as required to produce mortar color indicated.

1. Low-Alkali Cement: Portland cement for use with limestone shall contain no more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207.

C. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979/C 979M. Pigments shall have a record of satisfactory performance in mortar.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Davis Colors.
   b. Lanxess Corporation.
   c. Solomon Colors, Inc.


E. Colored Portland Cement-Lime Mix: Packaged blend of portland cement, hydrated lime, and mortar pigments. Mix shall produce color indicated or, if not indicated, as selected from manufacturer's standard colors. Pigments shall not exceed 10 percent of portland cement by weight.
1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. **Holcim (US) Inc.**
   b. **Lafarge North America Inc.**
   c. **Lehigh Hanson; HeidelbergCement Group.**

F. *Aggregate: ASTM C 144; except for joints narrower than 1/4 inch (6 mm) and pointing mortar, 100 percent shall pass No. 16 (1.18-mm) sieve.*

   1. **White Aggregates:** Natural white sand or ground white stone.
   2. **Colored Aggregates:** Natural-colored sand or ground marble, granite, or other durable stone; of color necessary to produce required mortar color.

G. *Water: Potable.*

2.6 **STONE ACCESSORIES**

A. **Setting Shims:** Strips of resilient plastic or vulcanized neoprene, Type A Shore durometer hardness of 50 to 70, nonstaining to stone, of thickness needed to prevent point loading of stone on anchors and of depths to suit anchors without intruding into required depths of pointing materials.

B. **Setting Buttons:** Resilient plastic buttons, nonstaining to stone, sized to suit joint thicknesses and bed depths of stone units without intruding into required depths of pointing materials.

C. **Concealed Sheet Metal Flashing:** Fabricated from zinc-tin, alloy-coated stainless steel in thicknesses indicated, but not less than 0.0156 inch (0.4 mm) thick, and complying with Section 076200 "Sheet Metal Flashing and Trim."

D. **Cementitious Dampproofing for Limestone:** Cementitious formulation recommended by ILI and nonstaining to stone; compatible with joint sealants and noncorrosive to anchors and attachments.

E. **Weep and Vent Tubes:** Medium-density polyethylene tubing, 1/4-inch (6-mm) OD, of length required to extend from exterior face of stone to cavity behind.

F. **Cellular Plastic Weep Hole/Vents:** One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, of length required to extend from exterior face of stone to cavity behind, in color selected from manufacturer's standard.

G. **Mesh Weep/Vent:** Free-draining mesh; made from polyethylene strands, of length required to extend from exterior face of stone to cavity behind, in color selected from manufacturer's standard.

H. **Wicking Material:** Absorbent rope, made from cotton or UV-resistant synthetic fiber, 1/4 to 3/8 inch (6 to 10 mm) in diameter, of length required to produce 2-inch (50-mm) exposure on exterior and 18 inches (450 mm) in cavity between wythes.

I. **Sealants for Joints in Stone Cladding:** Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants" and do not stain stone:

   1. **Joint Sealant:** Urethane, M, NS, 50, NT.
2. Joint-Sealant Colors: As selected by Architect from manufacturer's full range of colors.

2.7 STONE FABRICATION

A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated.
   1. For limestone, comply with recommendations in ILI's "Indiana Limestone Handbook."

B. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated. Shape beds to fit supports.

C. Cut and drill sinkages and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone securely in place.

D. Finish exposed faces and edges of stone to comply with requirements indicated for finish and to match approved samples and mockups.

E. Quirk-miter corners unless otherwise indicated; provide for cramp anchorage in top and bottom bed joints of corner pieces.

F. Cut stone to produce uniform joints 3/8 inch (10 mm) wide and in locations indicated.

G. Contiguous Work: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.

H. Fabricate molded work, including washes and drips, to produce stone shapes with a uniform profile throughout entire unit length, with precisely formed arris slightly eased to prevent snipping, and with matching profile at joints between units.
   1. Produce moldings and molded edges with machines that use abrasive shaping wheels made to reverse contour of molding shape.

I. Clean backs of stone to remove rust stains, iron particles, and stone dust.

J. Inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
   1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved samples and mockups.

2.8 MORTAR MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.
   1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated. Do not use calcium chloride.
2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer unless otherwise indicated. Discard mortar when it has reached initial set.

B. Portland Cement-Lime Setting Mortar: Comply with ASTM C 270, Proportion Specification, Type S.

C. Pointing Mortar: Comply with ASTM C 270, Proportion Specification, Type S. Provide pointing mortar mixed to match Architect's sample and complying with the following:
   1. Pigmented Pointing Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform source quality-control testing.
   1. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
   2. Furnish test specimens selected by testing agency from same blocks as actual materials proposed for incorporation into the Work.
   3. Flexural Strength Tests: ASTM C 880/C 880M, performed on specimens of same thickness, orientation of cut, and finish as installed stone. One set of test specimens is required to be tested for every 10,000 sq. ft. (1000 sq. m), but not fewer than two sets for each stone variety.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive stone cladding and conditions under which stone cladding will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone cladding.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of stone cladding.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING STONE CLADDING, GENERAL

A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

B. Coat limestone with dampproofing to extent indicated below:
1. Stone at Grade: Beds, joints, and back surfaces to at least 12 inches (300 mm) above finish-grade elevations.
2. Stone Extending Below Grade: Beds, joints, back surfaces, and face surfaces below grade.
3. Allow dampproofing to cure before setting dampproofed stone. Do not damage or remove dampproofing while handling and setting stone.

C. Parge back of travertine panels with mortar not less than 3/8 inch (10 mm) thick.

D. Execute stone cladding installation by skilled mechanics and employ skilled stone fitters at Project site to do necessary field cutting as stone is set.

1. Use power saws with diamond blades to cut stone. Produce lines cut straight and true, with edges eased slightly to prevent snipping.

E. Contiguous Work: Provide reveals, reglets, and openings as required to accommodate contiguous work.

F. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone cladding in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with uniform joints of widths indicated, and with edges and faces aligned according to established relationships and indicated tolerances.

G. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.

1. Sealing expansion and other joints is specified in Section 079200 "Joint Sealants."
2. Keep expansion joints free of mortar and other rigid materials.

H. Install concealed flashing at continuous shelf angles, lintels, ledges, and similar obstructions to downward flow of water, to divert water to building exterior. Extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.

3.3 SETTING STONE CLADDING WITH MORTAR

A. Set stone cladding with mortar and mechanical anchors unless otherwise indicated.

1. Provided anchors and attachments of type and size required to support the stonework fabricated from the following metals for conditions indicated below:
   a. Stainless Steel, AISI Type 304, for anchors and expansion bolts embedded within the stone.
   b. Hot-Dip Galvanized Steel as follows:
      1) Galvanized malleable iron for adjustable inserts embedded in the concrete structure.
      2) For anchor bolts, nuts and washers not in direct contact with stone; comply with ASTM A 307, Grade A, for material and ASTM C 153, Class C, for galvanizing.
      3) For steel plates, shapes and bars not in direct contact with stone; comply with ASTM A 36 for materials and ASTM A 123 for galvanizing.
      4) For expansion bolts not in direct contact with stone use zinc plated or cadmium plated bolts with stainless steel expansion clips.
      5) For steel angles supporting limestone; comply with ASTM A 36 for materials and ASTM A 123 for galvanizing.

B. Set stone in full bed of mortar with head joints filled unless otherwise indicated.
1. Use setting buttons of adequate size, in sufficient quantity, and of thickness required to maintain uniform joint width and to prevent mortar from extruding. Hold buttons back from face of stone a distance at least equal to width of joint, but not less than depth of pointing materials.

2. Do not set heavy units or projecting courses until mortar in courses below has hardened enough to resist being squeezed out of joint.

3. Support and brace projecting stones until wall above is in place and mortar has set.

4. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with mortar.

C. Fill space between back of stone units and backup wall solidly with mortar or grout.

D. Embed ends of sills in mortar; leave remainder of joint open until final pointing.

E. Rake out joints for pointing with mortar to depths of not less than 1/2 inch (12 mm). Rake joints to uniform depths with square bottoms and clean sides.

F. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply first layer of pointing mortar in layers not more than 3/8 inch (10 mm) until a uniform depth is formed.

G. Point stone joints by placing pointing mortar in layers not more than 3/8 inch (10 mm). Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.

H. Tool joints with a round jointer having a diameter 1/8 inch (3 mm) larger than width of joint, when pointing mortar is thumbprint hard.

I. Rake out mortar from sealant-pointed joints to depths required for sealant and sealant backing, but not less than 1/2 inch (12 mm). Rake joints to uniform depths with square bottoms and clean sides.

J. Set the following stone cladding with unfilled head joints for installing joint sealants:
   1. Cornices.
   2. Copings.
   4. Belt and other projecting courses.
   5. Wall caps.

3.4 JOINT-SEALANT INSTALLATION

A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.5 INSTALLATION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6 m), or 1/2 inch in 40 feet (12 mm in 12 m) or more. For external corners, corners and jambs within 20 feet (6 m) of an entrance, expansion joints, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch in 40 feet (10 mm in 12 m) or more.
B. Variation from Level: For lintels, sills, water tables, parapets, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (10 mm) maximum.

C. Variation of Linear Building Line: For positions shown in plan and related portions of walls and partitions, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (12 mm in 12 m) or more.

D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus 1/4 inch (6 mm).

E. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/8 inch (3 mm) or a quarter of nominal joint width, whichever is less. For joints within 60 inches (1500 mm) of each other, do not vary more than 1/8 inch (3 mm) or a quarter of nominal joint width, whichever is less from one to the other.

F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/16-inch (1.5-mm) difference between planes of adjacent units.

3.6 ADJUSTING AND CLEANING

A. Remove and replace broken, chipped, stained, or otherwise damaged stone, defective joints, and stone cladding that does not match approved samples and mockups. Damaged stone may be repaired if Architect approves methods and results.

B. Replace damaged or defective work in a manner that results in stone cladding's matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean stone cladding as work progresses. Remove mortar fins and smears before tooling joints. Remove excess sealant and smears as sealant is installed.

D. Final Cleaning: Clean stone cladding no fewer than six days after completion of pointing and sealing, using clean water and stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning agents containing caustic compounds or abrasives, or other materials or methods that could damage stone.

END OF SECTION 04 42 00
SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Structural Drawings, notify Architect for any discrepancies between this Section and the Drawings.

1.2 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Field-installed shear connectors.

B. Related Requirements:
   1. Refer to Notes on Structural Drawings. Contact Architect for determination on any conflicting information prior to ordering and fabrication.
   2. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
   3. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
   4. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other steel items not defined as structural steel.
   5. Section 099000 "Painting" for surface-preparation and priming requirements.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.
1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, shop-painting applicators, professional engineer, and testing agency.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control and special inspection reports.
1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector.

C. Shop-Painting Applicators: Qualified according to AISC’s Sophisticated Paint Endorsement P1 Endorsement P2 Endorsement P3 or to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

   1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

E. Comply with applicable provisions of the following specifications and documents:

   1. AISC 303.
   2. AISC 341 and AISC 341s1.
   3. AISC 360.
   4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of all connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified
professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using [schematic details indicated] and [AISC 360].
2. Use Allowable Stress Design; data are given at service-load level.

B. Moment Connections: Type PR, partially restrained.
C. Construction: Combined system of moment frame, braced frame, and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS
A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.
B. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
   1. W-Shapes: 60 percent.
   2. Channels, Angles, M, S-Shapes: 60 percent.
   3. Plate and Bar: 25 percent.
   4. Cold-Formed Hollow Structural Sections: 25 percent.
   5. Steel Pipe: 25 percent.
   6. All Other Steel Materials: 25 percent.
C. W-Shapes: ASTM A 992/A 992M or ASTM A 572/A 572M, Grade 50 (345).
D. Channels, Angles, M, S-Shapes: ASTM A 572/A 572M, Grade 50 (345).
E. Plate and Bar: ASTM A 36/A 36M.
F. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.
G. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.
   1. Weight Class: Standard
   2. Finish: Black except where indicated to be galvanized.
H. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.
I. Steel Forgings: ASTM A 668/A 668M.
J. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS
A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.

B. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.
   1. Finish: ot-dip or mechanically deposited inc coating.
   2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with mechanically deposited zinc coating finish.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
   1. Finish: Mechanically deposited zinc coating.

D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

E. Unheaded Anchor Rods: ASTM F 1554, Grade 36
   1. Configuration: [Straight].
   5. Finish: Plain.

F. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
   3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.

G. Threaded Rods: ASTM A 36/A 36M.
   2. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.


I. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.


2.4 PRIMER

A. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
2.5 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION


1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning." SSPC-SP 2, "Hand Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true
members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

H. Welded Door Frames: Build up welded door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches (250 mm) o.c. unless otherwise indicated.

I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
   3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC’s "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
   2. Surfaces to be field welded.
   4. Surfaces to receive sprayed fire-resistant materials (applied fireproofing).
   5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
   1. SSPC-SP 2, "Hand Tool Cleaning."
   2. SSPC-SP 3, "Power Tool Cleaning."
   3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
   4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
5. SSPC-SP 14/NACE No. 8, "Industrial Blast Cleaning."
6. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
7. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
8. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
9. SSPC-SP 8, "Pickling."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels shelf angles and welded door frames attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
4. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.


1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.

3.5 PREFABRICATED BUILDING COLUMNS

A. Install prefabricated building columns to comply with AISC 360, manufacturer's written recommendations, and requirements of testing and inspecting agency that apply to the fire-resistance rating indicated.

3.6 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.
B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
   1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
      c. Ultrasonic Inspection: ASTM E 164.
      d. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
   1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.7 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Painting: Cleaning and touchup painting are specified in Section 099000 Painting.

D. priming are specified in Section 099000 Painting.

END OF SECTION 05 12 00
SECTION 05 31 00 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Structural Drawings, notify Architect for any discrepancies between this Section and the Drawings.

1.2 SUMMARY

A. Section Includes:

1. Composite floor deck.
2. Noncomposite form deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
4. Section 099000 "Painting" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.
C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
   1. Power-actuated mechanical fasteners.
   2. Acoustical roof deck.

D. Evaluation Reports: For steel deck, from ICC-ES.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.


C. Electrical Raceway Units: Provide UL-labeled cellular floor-deck units complying with UL 209 and listed in UL's "Electrical Construction Equipment Directory" for use with standard header ducts and outlets for electrical distribution systems.


1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
   1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
C. **Recycled Content of Steel Products:** Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.2 COMPOSITE FLOOR DECK

A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. **CMC Joist & Deck.**
2. **Consolidated Systems, Inc.**
3. **Epic Metals Corporation.**
4. **Nucor Corp.**
5. **Verco Decking, Inc., a Nucor company.**

B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), G60 (180) zinc coating.
2. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), G60 (180) zinc coating; with unpainted top surface and cleaned and pretreated bottom surface primed with manufacturer's standard gray baked-on, rust-inhibitive primer.
3. Profile Depth: 1-1/2 inches (38 mm).
4. Design Uncoated-Steel Thickness: 0.0295 inch (0.75 mm).
5. Span Condition: As indicated on drawings.

2.3 NONCOMPOSITE FORM DECK

A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. **Canam Steel Corporation; Canam Group, Inc.**
2. **CMC Joist & Deck.**
3. **CSI Metal Dek Group.**
4. **Nucor Corp.**
5. **Verco Decking, Inc., a Nucor company.**

B. Noncomposite Form Deck: Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Uncoated Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 (230) minimum.
2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230) zinc coating.
3. Profile Depth: 9/16 inch (14 mm).
4. Design Uncoated-Steel Thickness: 0.0149 inch (0.38 mm).
5. Span Condition: As indicated on drawings.

2.4 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile indicated recommended by SDI Publication No. 31 for overhang and slab depth.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch (1.52 mm) thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.

J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.

K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck, with 3-inch- (76-mm-) wide flanges and sloped recessed pans of 1-1/2-inch (38-mm) minimum depth. For drains, cut holes in the field.

L. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: 3/4 inch (19 mm), nominal.
2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches (305 mm) apart, but not more than 18 inches (457 mm) apart.
3. Weld Spacing: Space and locate welds as indicated.
4. Weld Washers: Install weld washers at each weld location.
B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches (914 mm), and as follows:

1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.
3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped or butted at Contractor's option.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

F. Install piercing hanger tabs at 14 inches (355 mm) apart in both directions, within 9 inches (228 mm) of walls at ends, and not more than 12 inches (305 mm) from walls at sides unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Prepare test and inspection reports.

3.5 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099000 "Painting."

C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099000 "Painting."

END OF SECTION 05 31 00
SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Steel framing and supports for operable partitions.
   2. Steel framing and supports for overhead doors and grilles.
   3. Steel framing and supports for countertops.
   4. Steel tube reinforcement for low partitions.
   5. Steel framing and supports for mechanical and electrical equipment.
   6. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   7. Elevator machine beams, hoist beams, and divider beams.
   8. Steel shapes for supporting elevator door sills.
   9. Steel girders for supporting wood frame construction.
  10. Steel pipe columns for supporting wood frame construction.
  11. Shelf angles.
  12. Metal floor plate and supports.
  14. Miscellaneous steel trim including steel angle corner guards, steel edgings and loading-dock edge angles.
  15. Metal bollards.
  16. Pipe Downspout guards.
  17. Cast-iron wheel guards.
  18. Metal downspout boots.

B. Products furnished, but not installed, under this Section include the following:

  1. Loose steel lintels.
  2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
  3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:

  1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
  2. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
3. Section 051200 "Structural Steel Framing."

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers’ written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Paint products.

B. Sustainable Design Submittals:

1. **Product Data**: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for operable partitions.
2. Steel framing and supports for overhead doors and grilles.
3. Steel framing and supports for countertops.
4. Steel tube reinforcement for low partitions.
5. Steel framing and supports for mechanical and electrical equipment.
6. Steel framing and supports for applications where framing and supports are not specified in other Sections.
7. Elevator machine beams, hoist beams, and divider beams.
8. Steel shapes for supporting elevator door sills.
9. Steel girders for supporting wood frame construction.
10. Steel pipe columns for supporting wood frame construction.
11. Shelf angles.
12. Metal ladders.
13. Metal floor plate and supports.
15. Miscellaneous steel trim including steel angle corner guards steel edgings platform edge angles.
16. Metal bollards.
17. Pipe Downspout guards.
18. Cast-iron wheel guards.
19. Metal downspout boots.
20. Loose steel lintels.

1.5 INFORMATONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:

   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
   3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
B. **Recycled Content of Steel Products**: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 5 percent.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.

E. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

F. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

G. Rolled-Stainless-Steel Floor Plate: ASTM A 793.

H. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

I. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

J. Zinc-Coated Steel Wire Rope: ASTM A 741.
   1. Wire-Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

K. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
   1. Size of Channels: As indicated.
   2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, with G90 (275) coating; 0.108-inch (2.8-mm) nominal thickness.
   3. Material: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B; 0.0966-inch (2.5-mm) minimum thickness; unfinished at interior, hot-dip galvanized after fabrication at exterior.

L. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.


P. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.


R. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).


2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.
4. Provide bronze fasteners for fastening bronze.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3 (ASTM A 325M, Type 3); with hex nuts, ASTM A 563, Grade C3 (ASTM A 563M, Class 8S3); and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy as specified on structural drawings.

E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.
2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099000 “Painting.”

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

E. Concrete: Comply with requirements in Section 033000 ”Cast-in-Place Concrete” for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.

1. Unless otherwise indicated, fabricate from Schedule 40 steel pipe.
2. Unless otherwise indicated, provide 1/2-inch (12.7-mm) baseplates with four 5/8-inch (16-mm) anchor bolts and 1/4-inch (6.4-mm) top plates.

E. Galvanize miscellaneous framing and supports where indicated.

F. Prime miscellaneous framing and supports with primer specified in Section 099000 "Painting" where indicated.

2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
C. Galvanize and prime shelf angles located in exterior walls.
D. Prime shelf angles located in exterior walls with primer specified in Section 099000 “Painting.”
E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 ELEVATOR PIT SUMP COVERS
A. Fabricate from 3/16-inch (4.8-mm) abrasive-surface floor plate with four 1-inch- (25-mm-) diameter holes for water drainage and for lifting.
B. Fabricate from welded or pressure-locked steel bar grating Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
C. Provide steel angle supports as indicated.

2.9 MISCELLANEOUS STEEL TRIM
A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
   1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
C. Galvanize and prime exterior miscellaneous steel trim.
D. Prime exterior miscellaneous steel trim with primer specified in Section 099600 "High-Performance Coatings."

2.10 METAL BOLLARDS
A. Fabricate metal bollards from Schedule 40 steel pipe.
   1. Cap bollards with 1/4-inch- (6.4-mm-) thick steel plate.
   2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
   3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
B. Fabricate bollards with 3/8-inch- (9.5-mm-) thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch (19-mm) anchor bolts.
   1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
C. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch- (6.4-mm-) thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard.

D. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch (6.4-mm) wall-thickness steel tubing with an OD approximately 1/16 inch (1.5 mm) less than ID of bollards. Match drill sleeve and bollard for 3/4-inch (19-mm) steel machine bolt.

E. Prime bollards with primer specified in Section 099600 "High-Performance Coatings."

2.11 METAL DOWNSPOUT BOOTS

A. Provide downspout boots made from cast aluminum in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.

1. Outlet: Vertical, to discharge into pipe.

B. Prime cast downspout boots with primer specified in Section 099600 "High-Performance Coatings."

2.12 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates.

C. Prime plates with primer specified in Section 099113 "Exterior painting"

2.13 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.

C. Galvanize and prime loose steel lintels located in exterior walls.

D. Prime loose steel lintels located in exterior walls with primer specified in Section 099113 "Exterior painting"

2.14 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.
2.15 FINISHES, GENERAL
   A. Finish metal fabrications after assembly.
   B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.16 STEEL AND IRON FINISHES
   A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
      1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
   B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
   C. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or at interior scheduled for clear, glazed, or bluing-type finish or unless otherwise indicated.
      1. Shop prime with primers specified in Section 099000 "Painting." NOTE: All exterior steel shall have high performance exterior coating.
   D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
      3. Other Items: SSPC-SP 3, "Power Tool Cleaning."
   E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
      1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.17 ALUMINUM FINISHES
   A. As-Fabricated Finish: AA-M12.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
   1. Cast Aluminum: Heavy coat of bituminous paint.
   2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions, overhead doors and overhead grilles securely to, and rigidly brace from, building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
   1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
   1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING METAL BOLLARDS

A. Coordinate installation of bollards with details on Plans.

B. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
   1. Do not fill removable bollards with concrete.

C. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete in formed or core-drilled holes not less than 24 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard. Fill annular space around bollard solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward bollard.

D. Anchor internal sleeves for removable bollards in concrete by inserting in pipe sleeves preset into concrete. Fill annular space around internal sleeves solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward internal sleeve.

E. Anchor internal sleeves for removable bollards in place with concrete footings. Center and align sleeves in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.

F. Place removable bollards over internal sleeves and secure with 3/4-inch (19-mm) machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner furnishes padlocks.

G. Fill bollards solidly with concrete, mounding top surface to shed water.
   1. Do not fill removable bollards with concrete.

3.4 INSTALLING BEARING AND LEVELING PLATES


B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099000 “Painting.”

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 50 00
SECTION 05 51 13 - METAL PAN STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Preassembled steel stairs with concrete-filled treads.
   2. Steel tube railings attached to metal stairs.
   3. Steel tube handrails attached to walls adjacent to metal stairs.

B. Related Requirements:
   1. Section 033000 "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
   2. Section 055213 "Pipe and Tube Railings" for pipe and tube railings.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so that they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

1.4 ACTION SUBMITTALS

A. Product Data: For metal pan stairs and the following:
   1. Prefilled metal-pan-stair treads.
   2. Precast concrete treads.
   3. Epoxy-resin-filled stair treads.
   4. Nonslip aggregates and nonslip-aggregate finishes.
   5. Abrasive nosings.
B. Sustainable Design Submittals:
   1. **Product Data**: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Samples for Verification: For each type and finish of [nosing] and [tread].

### 1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

### 1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. All metal pan stairs to be designed by registered Tennessee Engineer. Shop drawings for stairs to be stamped by engineer.

C. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

A. **Manufacturers**: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. **Alfab, Inc.**
   2. **American Stair, Inc.**
   3. **Lapeyre Stair Inc.**

#### 2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Uniform Load: 100 lb/sq. ft. (4.79 kN/sq. m).
   2. Concentrated Load: 300 lb (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
   3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.

B. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:
   a. Uniform load of 50 lb/ft. (0.73 kN/m) applied in any direction.
   b. Concentrated load of 200 lb (0.89 kN) applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:
   a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
   b. Infill load and other loads need not be assumed to act concurrently.

2.3 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 5 percent.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.

E. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.


F. Perforated Metal: Cold-rolled steel sheet, ASTM A 1008/A 1008M, or hot-rolled steel sheet, ASTM A 1011/A 1011M, commercial steel Type B, 0.060 inch (1.52 mm) thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows.

G. Perforated Metal: Galvanized-steel sheet, ASTM A 653/A 653M, G90 (Z275) coating, commercial steel Type B, 0.064 inch (1.63 mm) thick, with 1/4-inch (6.4-mm) holes in staggered rows.

H. Woven-Wire Mesh: Intermediate-crimp, square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal diameter wire complying with ASTM A 510 (ASTM A 510M).

2.4 ABRASIVE NOSINGS

A. Extruded Units: Aluminum units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.

1. **Managers**: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. American Safety Tread Co., Inc.
   b. Balco, Inc.
   c. Wooster Products Inc.

2. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.

3. Nosings: Square-back units, 1-7/8 inches (48 mm) wide, without lip.

B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

C. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.

D. Apply clear lacquer to concealed surfaces of extruded units set into concrete.

2.5 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/ln 12 for exterior use, and Class Fe/ln 5 where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for exterior stairs.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/ln 5, unless otherwise indicated.
2.6 MISCELLANEOUS MATERIALS

A. **Shop Primers: Provide primers that comply with Section 099000 - Painting.**

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI 79 and compatible with topcoat.

   1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

F. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa) unless otherwise indicated.

G. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.

H. Welded Wire Reinforcement: ASTM A 185/A 185M, 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated.

2.7 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

   1. Join components by welding unless otherwise indicated.
   2. Use connections that maintain structural value of joined pieces.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 4 welds: good quality, uniform undressed weld with minimal splatter.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

2.8 STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," Commercial Class, unless more stringent requirements are indicated.

B. Stair Framing:
   1. Fabricate stringers of steel plates or channels.
      a. Provide closures for exposed ends of channel stringers.
   2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements.
   3. Weld stringers to headers; weld framing members to stringers and headers.
   4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.
   5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness indicated.
   1. Steel Sheet: Uncoated cold-rolled steel sheet.
   2. Directly weld metal pans to stringers; locate welds on top of subtreads where they are concealed by concrete fill. Do not weld risers to stringers.
   3. Shape metal pans to include nosing integral with riser.
   4. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.

2.9 FINISHES

A. Finish metal stairs after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLING METAL PAN STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

G. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

1. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.

H. Install precast concrete treads with adhesive supplied by manufacturer.

3.2 INSTALLING RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
1. Anchor posts to steel by welding to steel supporting members.
2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.

B. Attach handrails to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements.
   1. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099000 - Painting.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 51 13
SECTION 05 51 33 – METAL LADDERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Interior steel vertical ladders.

B. Products furnished, but not installed, under this Section include the following:
   1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Requirements:
   1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
   2. Section 051200 "Structural Steel Framing."

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers’ written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Prefabricated ladders.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal ladder fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
   1. Metal ladders.

C. Delegated-Design Submittal: For all ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.
B. Welding certificates.
C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
D. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
B. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

E. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

F. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
G. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
   1. Size of Channels: 1-5/8 by 1-5/8 inches (41 by 41 mm) minimum.

H. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class F e/n 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1 (A1).

E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
   1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
   1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class F e/n 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Shop Primers: Provide primers that comply with Section 099100 "Painting."

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI 79 and compatible with topcoat.
   1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

D. Epoxy Zinc-Rich Primer: Complying with MPI 20 and compatible with topcoat.
E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
   1. Fabricate units from slotted channel framing where indicated.
   2. Furnish inserts for units installed after concrete is placed.

C. Prime miscellaneous framing and supports with primer specified in Section 099600 "High-Performance Coatings" where indicated.

2.7 METAL LADDERS

A. General:
   2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Vertical Ladders:
   1. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
   2. Siderails: Continuous, 1/2-by-2-1/2-inch (12.7-by-64-mm) steel flat bars, with eased edges.
   4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
   5. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
      a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:
         1) Harsco Industrial IKG, a division of Harsco Corporation; Mebac.
         2) SlipNOT Metal Safety Flooring, a division of W. S. Molnar Company; SlipNOT.
         3) Other manufacturers as submitted by General Contractor and approved by Architect.
   6. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
   7. Prime interior ladders, including brackets and fasteners, with primer specified in Section 099600 "High-Performance Coatings."

2.8 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for ladder items supported from concrete or masonry construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.9 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.10 STEEL AND IRON FINISHES

A. Shop prime interior iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
   1. Shop prime with universal shop primer unless otherwise indicated.

B. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Apply by brush or spray to provide a minimum 2.0-mil (0.05 mm) dry film thickness on steel surfaces.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099100 "Painting."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 51 33
SECTION 05 52 13 – CUSTOM STEEL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Steel railings.

B. Related Requirements:
   1. Section 055113 "Metal Pan Stairs" for steel tube railings associated with metal pan stairs.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers’ written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Manufacturer’s product lines of mechanically connected railings.
   2. Railing brackets.

B. Sustainable Design Submittals:
   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
D. Samples: For each type of exposed finish required.
   1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
   2. Fittings and brackets.
   3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
      a. Show method of connecting and finishing members at intersections.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

E. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

F. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
   3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Steel Pipe and Tube Railings:
   1. Manufacturer is to be the same fabricator as the structural steel, or by a shop with 5 years or more experience in custom rail fabrication.

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
      b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.
   2. Infill of Guards:
      a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
      b. Infill load and other loads need not be assumed to act concurrently.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C, material surfaces).

2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
   1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface. Match profile indicated in drawings.

2.4 STEEL AND IRON

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
B. Tubing: ASTM A 500 (cold formed) or ASTM A 513.

C. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

D. Plates, Shapes, and Bars: ASTM A 36/A 36M.

E. Perforated Metal: Cold-rolled steel sheet, ASTM A 1008/A 1008M, or hot-rolled steel sheet, ASTM A 1011/A 1011M, commercial steel Type B, 0.060 inch (1.52 mm) thick, with 1/4-inch (6.4-mm) holes in staggered rows.


F. Woven-Wire Mesh: Intermediate-crimp, square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.134-inch-(3.42-mm-) diameter wire complying with ASTM A 510 (ASTM A 510M).

2.5 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
3. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Section 099000 “Painting.”
   1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Intermediate Coats and Topcoats: Provide products that comply with Section 099000 “Painting.”

D. Epoxy Intermediate Coat: Complying with MPI 77 and compatible with primer and topcoat.

E. Polyurethane Topcoat: Complying with MPI 72 and compatible with undercoat.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

H. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
   1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.7 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.
H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove flux immediately.
   4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
   1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

J. Form Changes in Direction as Follows:
   1. As detailed.

K. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of railing members with prefabricated end fittings.

M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
   1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

P. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

Q. For removable railing posts, fabricate slip-fit sockets from stainless-steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
   1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
R. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from galvanized steel or same metal as railings in which they are installed.
   1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch (1.1 mm) thick.
   2. Orient perforated metal with pattern parallel to top rail horizontal or as indicated on Drawings.

S. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) metal channel frames. Make wire mesh and frames from same metal as railings in which they are installed.
   1. Orient wire mesh with wires perpendicular and parallel to top rail or as indicated on Drawings.

T. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.8 STEEL AND IRON FINISHES

A. Galvanized Railings:
   1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
   2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
   4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
   5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.

E. Preparation for Shop Priming and for clear/patina finish: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   4. Other Railings: SSPC-SP 3, "Power Tool Cleaning."

F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
1. Shop prime uncoated railings with primers specified in Section 099000 "Painting" unless indicated.
2. Do not apply primer to galvanized surfaces.

G. Shop-Painted Finish: Comply with Section 099000 "Painting."
   1. Color: As selected by Architect from manufacturer's full range.

H. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
   1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL
   A. Fit exposed connections together to form tight, hairline joints.
   B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
      1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
      2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
      3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
   C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
      1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
   D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
   E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.
3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, attached to post with set screws.

D. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.
2. For stainless-steel pipe railings, weld flanges to post and bolt to supporting surfaces.
3. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

E. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to floor/wall construction or connected to railing ends using nonwelded connections.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends using nonwelded connections.

C. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:
1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed partitions, use hanger or lag bolts set into wood blocking between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.
B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05 52 13
SECTION 06 03 12 - HISTORIC WOOD REPAIR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes historic treatment of wood in the form of repairing wood features as follows:

1. Repairing wood trim.
2. Replacing wood trim.
3. Repairing, refinishing, and replacing hardware.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 024296 "Historic Removal and Dismantling" for historic removal and dismantling work.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic wood repair.
2. Review methods and procedures related to historic wood repair, including, but not limited to, the following:

   a. Historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
   b. Materials, material application, sequencing, tolerances, and required clearances.
   c. Fire-protection plan.
   d. Wood historic treatment program.
   e. Coordination with building occupants.

1.4 SEQUENCING AND SCHEDULING

A. Perform historic wood repair in the following sequence, which includes work specified in this and other Sections:

1. Before removing wood components for on-site or off-site repair, tag each component with location identification numbers. Indicate on tags and building plans the locations of each component, such as "Baseboard on North Side of Room 101."
2. Dismantle hardware and tag with location-identification numbers.
3. In the shop, label each repaired component and whole or partial replacement with permanent location-identification number in inconspicuous location and remove site-applied tags.
4. Sort units by condition, separating those that need extensive repair.
5. Clean surfaces.
6. General Wood-Repair Sequence:
   a. Remove paint to bare wood.
   b. Repair wood by consolidation, replacement, partial replacement, and patching.
   c. Sand, prime, fill, sand again, and prime surfaces again for refinishing.
7. Repair, refinish, and replace hardware if required. Reinstall operating hardware.
8. Reinstall components.
9. Apply finish coats.
10. Install remaining hardware.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include recommendations for product application and use. Include test data substantiating that products comply with requirements.

B. Shop Drawings:
   1. Include plans, elevations, and sections showing locations and extent of repair and replacement work, with enlarged details of replacement parts indicating materials, profiles, joinery, reinforcing, method of splicing or attaching wood members to other surfaces, accessory items, and finishes.
   2. Include field-verified dimensions and the following:
      a. Full-size shapes and profiles with complete dimensions for replacement components and their jointing, showing relationship of existing components to new components.
      b. Templates and directions for installing hardware and anchorages.
      c. Identification of each new unit and its corresponding location in the building on annotated plans and elevations.
      d. Provisions for sealant joints as required for location.

C. Samples for Initial Selection: For each type of exposed wood and finish.
   1. Identify wood species, cut, and other features.
   2. Include Samples of hardware and accessories involving color selection.

D. Samples for Verification: For the following products in manufacturer's standard sizes unless otherwise indicated, finished as required for use in the Work:
   1. Replacement Wood: 12-inch- (300-mm-) long, full-size molding sections with applied finish.
      a. Additional Samples of replacement members that show fabrication techniques, materials, and finishes as requested by Architect.
2. Repaired Wood: Prepare Samples using existing wood removed from site, repaired, and prepared for refinishing.
3. Refinished Wood: Prepare Samples using existing wood removed from site, repaired, and refinished.
4. Hardware: Full-size units with each factory-applied or restored finish.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For historic treatment specialist including workers and wood-repair-material manufacturer.
B. Wood Historic Treatment Program: Submit before work begins.
C. Preconstruction Test Reports: For historic wood repair.

1.7 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic wood-repair specialist, experienced in repairing, refinishing, and replacing wood in whole and in part. Experience only in fabricating and installing new woodwork is insufficient experience for wood historic treatment work.
B. Wood-Repair-Material Manufacturer Qualifications: A firm regularly engaged in producing wood consolidant and wood-patching compound that have been used for similar historic wood-treatment applications with successful results, and with factory-authorized service representatives who are available for consultation, Project-site inspection, and on-site assistance.
C. Wood Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for historic treatment work, including protection of surrounding materials and Project site.
   1. If materials and methods other than those indicated are proposed for any phase of historic treatment work, add a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.
D. Mockups: Prepare mockups of historic treatment repair processes to demonstrate aesthetic effects and to set quality standards for materials and execution, and for fabrication and installation. Prepare mockups so they are as inconspicuous as practicable.
   1. Locate mockups on existing surfaces where directed by Architect or in locations that enable viewing under same conditions as the completed Work.
   2. Wood Baseboard Repair: Prepare an approximately 72-inch (2000-mm) length of baseboard to serve as mockup to demonstrate samples of each type of wood repair.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified historic treatment specialist to perform preconstruction testing on historic wood materials as follows:

1. Provide test specimens representative of proposed materials and existing construction.
2. Test historic treatment products and methods for effectiveness and compliance with specified requirements.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Pack, deliver, and store products in suitable packs, heavy-duty cartons, or wooden crates; surround with sufficient packing material to ensure that products will not be deformed, broken, or otherwise damaged.

B. Until installed, store products inside a well-ventilated area and protect from weather, moisture, soiling, abrasion, extreme temperatures, and humidity, and where environmental conditions comply with manufacturer's requirements.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with historic wood repair only when existing and forecasted weather conditions are within the environmental limits set by each manufacturer's written instructions and specified requirements.

PART 2 - PRODUCTS

2.1 HISTORIC WOOD REPAIR, GENERAL

A. Quality Standard: Comply with applicable requirements in Section 12, "Historic Restoration Work," and related requirements in AWI/AWMAC/WI's "Architectural Woodwork Standards" for construction, finishes, grade rules, and other requirements unless otherwise indicated.


2.2 REPLICATED WOOD ITEMS

A. Replicated Wood Trim: Custom-fabricated replacement wood units and components.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   b. Highland Restoration, Inc.
   c. Traditional Builders Inc.

2. Joint Construction: Joints matching existing joints.
3. Wood Species: Match species of existing wood; or use White Oak at exterior locations, and poplar at interior locations if historic wood is dense heart pine or other species not readily replicable, available, and affordable.

4. Wood Cut: Match cut of existing wood if grain is apparent.

5. Wood Member and Trim Profiles: Match profiles and detail of existing.

6. Hardware: Reuse existing unless otherwise indicated. Where none is available or appropriate for reuse, match existing hardware unless otherwise indicated. Use new hardware where indicated, such as at door locksets.

2.3 WOOD-REPLACEMENT MATERIALS

A. Wood, General: Clear fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide.

1. Species: Match species of each existing type of wood component or assembly unless otherwise indicated.

B. Exterior Trim and Brackets: Match existing species.

C. Interior Trim and doors: Match existing species.

2.4 WOOD-REPAIR MATERIALS

A. Source Limitations: Obtain wood consolidant and wood-patching compound from single source from single manufacturer.

B. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated due to weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Abatron, Inc.
   b. ConServ Epoxy LLC.
   c. Gougeon Brothers, Inc.
   d. Protective Coating Company.
   e. System Three Resins, Inc.

C. Wood-Patching Compound: Two-part, epoxy-resin, wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound shall be capable of filling deep holes and spreading to featheredge.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Abatron, Inc.
   b. Advanced Repair Technology, Inc.
2.5 HARDWARE

A. Hardware, General: Provide hardware required for each type of replicated or repaired wood, including but not limited to, hinges, pulls, latches, fasteners, and accessories indicated or required for proper operation. Hardware shall smoothly operate, tightly close, and secure units appropriately for frequency of use, unit weight, and dimensions.

B. Replacement Hardware: Replace existing damaged or missing hardware with new hardware manufactured by manufacturers of new hardware indicated in other sections of this specification.

C. Material and Design:

1. Material: Match existing hardware unless otherwise indicated.
2. Design: Match type and appearance of existing hardware.
3. Replacement Hardware: Regardless of mechanisms within, match existing, exposed hardware of the following types:
   a. Hinges.
4. Date Identification: Emboss on a concealed surface of the metal body of each new hardware item, in easily read characters, "MADE 2017." Manufacturer's name may also be embossed. For cast iron or other brittle metals, add the identification to the mold pattern before casting. For malleable metals, stamp identification with an imprinting tool.

D. Hardware Finishes: Comply with BHMA A156.18 for base material and finish requirements indicated by the following:

1. BHMA 605: Bright brass, clear-coated; brass base metal.
2. BHMA 606: Satin brass, clear-coated; brass base metal.
3. BHMA 611: Bright bronze, clear-coated; bronze base metal.
4. BHMA 612: Satin bronze, clear-coated; bronze base metal.
5. BHMA 613: Dark-oxidized satin bronze, oil-rubbed; bronze base metal.
6. BHMA 624: Dark-oxidized statuary bronze, clear-coated; bronze base metal.
7. BHMA 628: Satin aluminum, clear anodized; aluminum base metal.
8. BHMA 630: Satin stainless steel; stainless-steel base metal.
9. BHMA 689: Aluminum painted; over any base metal.

2.6 MISCELLANEOUS MATERIALS

A. Borate Preservative Treatment: Inorganic, borate-based solution, with disodium octaborate tetrahydrate as the primary ingredient; manufactured for preserving weathered and decayed wood from further damage caused by fungi and wood-boring insects; complying with AWPA P5; containing no boric acid.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Abatron, Inc.
b. Nisus Corporation.
c. System Three Resins, Inc.

B. Cleaning Materials:

1. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for each 5 gal. (20 L) of solution required.

2. Mildewcide: Commercial, proprietary mildewcide or a solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.

C. Adhesives: Wood adhesives with minimum 15- to 45-minute cure at 70 deg F (21 deg C), in gunnable and liquid formulations as recommended in writing by adhesive manufacturer for each type of repair and exposure condition.

D. Fasteners: Use fastener metals that are noncorrosive and compatible with each material joined.

1. Match existing fasteners in material and type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting wood components.
3. Use concealed fasteners for attaching items to other work unless exposed fasteners are unavoidable.
4. For fastening metals, use fasteners of same basic metal as fastened metal unless otherwise indicated.
5. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
6. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

2.7 WOOD FINISHES

A. Unfinished Replacement Units: Provide exposed exterior and interior wood surfaces of replacement units unfinished; smooth, filled, and suitably prepared for on-site priming and finishing.

1. Finish Coats: Match intermediate coat and topcoat products used for nearby, repaired wood, as specified in Section 090391 "Historic Treatment of Plain Painting."

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect adjacent materials from damage by historic wood repair.

B. Clean wood of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.
3.2 HISTORIC WOOD REPAIR, GENERAL

A. Historic Treatment Appearance Standard: Completed work is to have a uniform appearance as viewed by Architect from 5 feet (1.5 m) away for interior work and from 20 feet away for exterior work.

B. General: In treating historic items, disturb them as minimally as possible and as follows:

1. Stabilize and repair wood to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
2. Remove coatings and apply borate preservative treatment before repair. Remove coatings according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.
3. Repair items in place where possible.
4. Install temporary protective measures to protect wood-treatment work that is indicated to be completed later.
5. Refinish historic wood according to Section 090391 "Historic Treatment of Plain Painting" unless otherwise indicated.

C. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use only the gentlest mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail. Do not use abrasive methods, such as sanding, wire brushing, or power tools, except as indicated as part of the historic treatment program and as approved by Architect.

D. Repair and Refinish Existing Hardware: Dismantle hardware; strip paint, repair, and refinish it to match finish samples; and lubricate moving parts just enough to function smoothly.

E. Repair Wood: Match existing materials and features, retaining as much original material as possible to perform repairs.

1. Unless otherwise indicated, repair wood by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.
2. Where indicated, repair wood by limited replacement matching existing material.

F. Replace Wood: Where indicated, duplicate and replace units with units made from salvaged, sound, original wood or with new wood matching existing wood. Use surviving prototypes to create patterns for duplicate replacements.

1. Do not use substitute materials unless otherwise indicated.
2. Compatible substitute materials may be used.

G. Identify removed items with numbering system corresponding to item locations, to ensure reinstallation in same location. Key items to Drawings showing location of each removed unit. Permanently label units in a location that will be concealed after reinstallation.
3.3 WOOD PATCH-TYPE REPAIR

A. General: Patch wood that exhibits depressions, holes, or similar voids, and that has limited amounts of rotted or decayed wood.

1. Verify that surfaces are sufficiently clean and free of paint residue prior to patching.
2. Treat wood with wood consolidant prior to application of patching compound. Coat wood surfaces by brushing, applying multiple coats until wood is saturated and refuses to absorb more. Allow treatment to harden before filling void with patching compound.
3. Remove rotted or decayed wood down to sound wood.

B. Apply borate preservative treatment to accessible surfaces either before applying wood consolidant or after removing rotted or decayed wood. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom. Allow treatment to dry.

C. Apply wood-patching compound to fill depressions, nicks, cracks, and other voids created by removed or missing wood.

1. Prime patch area with application of wood consolidant or manufacturer’s recommended primer.
2. Mix only as much patching compound as can be applied according to manufacturer’s written instructions.
3. Apply patching compound in layers as recommended in writing by manufacturer until the void is completely filled.
4. Sand patch surface smooth and flush with adjacent wood, without voids in patch material, and matching contour of wood member.
5. Clean spilled compound from adjacent materials immediately.

3.4 WOOD-REPLACEMENT REPAIR

A. General: Replace parts of or entire wood items at locations indicated on Drawings and where damage is too extensive to patch.

1. Remove surface-attached items from wood surface before performing wood-replacement repairs unless otherwise indicated.
2. Verify that surfaces are sufficiently clean and free of paint residue prior to repair.
3. Remove broken, rotted, and decayed wood down to sound wood.
4. Custom fabricate new wood to replace missing wood; either replace entire wood member or splice new wood part into existing member.
5. Secure new wood using finger joints, multiple dowels, or splines with adhesive and nailing to ensure maximum structural integrity at each splice. Use only concealed fasteners. Fill nail holes and patch surface to match surrounding sound wood.

B. Apply borate preservative treatment to accessible surfaces after replacements are made. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.

C. Repair remaining depressions, holes, or similar voids with patch-type repairs.

D. Clean spilled materials from adjacent surfaces immediately.

E. Reinstall items removed for repair into original locations.
3.5 FIELD QUALITY CONTROL

A. Manufacturers Field Service: Engage wood-repair-material manufacturers’ factory-authorized service representatives for consultation and Project-site inspection, and provide on-site assistance when requested by Architect.

3.6 ADJUSTMENT

A. Adjust existing and replacement operating items, hardware, and accessories for a tight fit at contact points and for smooth operation and tight closure. Lubricate hardware and moving parts.

3.7 CLEANING AND PROTECTION

A. Protect wood surfaces from contact with contaminating substances resulting from construction operations. Monitor wood surfaces adjacent to and below exterior concrete and masonry during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances contact wood surfaces, remove contaminants immediately.

B. Clean exposed surfaces immediately after historic wood repair. Avoid damage to coatings and finishes. Remove excess sealants, patching materials, dirt, and other substances.

END OF SECTION 06 03 12
SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Framing with dimension lumber.
   2. Framing with engineered wood products.
   3. Wood blocking, fireblocking, cants, and nailers.
   5. Utility shelving.
   6. Plywood backing panels.

B. Related Requirements:
   1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. OSB: Oriented strand board.

E. Timber: Lumber of 5 inches nominal (114 mm actual) size or greater in least dimension.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.

4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Sustainable Design Submittals:

1. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.

C. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Shear panels.
5. Power-driven fasteners.
6. Post-installed anchors.
7. Metal framing anchors.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Regional Materials: The following wood products shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

1. Dimension lumber.
2. Laminated-veneer lumber.
5. Rim boards.

B. Regional Materials: The following wood products shall be manufactured within 500 miles (800 km) of Project site.

1. Dimension lumber.
2. Laminated-veneer lumber.
5. Rim boards.

C. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.

D. Maximum Moisture Content of Lumber: 15 percent (38-mm actual) thickness or less, no limit for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

E. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlsspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.

F. Application: Treat items indicated on Drawings, and the following:
   1. Framing for raised platforms.
   2. Framing for stages.
   3. Concealed blocking.
   4. Framing for non-load-bearing partitions.
   5. Framing for non-load-bearing exterior walls.
   6. Roof construction.
   7. Plywood backing panels.

2.4 ENGINEERED WOOD PRODUCTS

"Composite Wood Products" Paragraph below applies to LEED 2009 NC, CI, and CS Credit IEQ 4.4.

A. Composite Wood Products: Products shall be made without urea formaldehyde.

"Composite Wood Products" Paragraph below applies to LEED 2009 for Schools Credit IEQ 4.4.

B. Composite Wood Products: Products shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.

D. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.

   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Finnforest USA.
      b. Georgia-Pacific Building Products.
      c. Weyerhaeuser Company.

   2. Extreme Fiber Stress in Bending, Edgewise: 2600 psi (17.9 MPa) for 12-inch nominal- (286-mm actual-) depth members.

   3. Modulus of Elasticity, Edgewise: 1,900,000.

E. Parallel-Strand Lumber: Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.
1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Louisiana-Pacific Corporation.
   b. Weyerhaeuser Company.

2. Extreme Fiber Stress in Bending, Edgewise: 2900 psi (20 MPa) for 12-inch nominal- (286-mm actual-) depth members.

3. Modulus of Elasticity, Edgewise: 2,200,000 psi (15 100 MPa).

2.5 **MISCELLANEOUS LUMBER**

A. **General:** Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.
   3. Rooftop equipment bases and support curbs.
   5. Grounds.

B. **Dimension Lumber Items:** Construction or No. 2 grade lumber of the following species:
   1. Mixed southern pine or southern pine; SPIB.

C. **Utility Shelving:** Lumber with 15 percent maximum moisture content of the following species and grades:
   1. Mixed southern pine or southern pine; No. 2 grade; SPIB.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.6 **PLYWOOD BACKING PANELS**

A. Communications Equipment backboard: ¾” thick, A-D, group 1, interior.

2.7 **FASTENERS**

A. **General:** Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/ i n 5.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

E. Install shear wall panels to comply with manufacturer's written instructions.

F. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

G. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

H. Do not splice structural members between supports unless otherwise indicated.

I. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
J. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal (38-mm actual) thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.

K. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

L. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

M. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

N. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

O. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000
SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Subflooring.
   2. Underlayment.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
   3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
   4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Sustainable Design Submittals:

   1. Product Data: For installation adhesives, indicating VOC content.
   2. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

   1. Wood-preservative-treated plywood.
   2. Fire-retardant-treated plywood.
   3. Foam-plastic sheathing.
1.5 QUALITY ASSURANCE
   
   A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING
   
   A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   
   A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      
      1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WOOD PANEL PRODUCTS
   
   A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
   
   B. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD
   
   A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
      
      1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
   
   B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
   
   C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.
2.4 SUBFLOORING AND UNDERLAYMENT

A. Plywood Combination Subfloor-Underlayment: DOC PS 1, Exposure 1, Underlayment single-floor panels.
   1. Span Rating: Not less than 16.
   2. Nominal Thickness: As shown on Drawings.
   3. Edge Detail: Tongue and groove.

B. Plywood Subflooring: DOC PS 1, Exposure 1 single-floor panels or sheathing.
   1. Span Rating: Not less than 16.
   2. Nominal Thickness: As shown on Drawings

C. Underlayment: Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than 1/2 inch (6.4 mm) over smooth subfloors and not less than 1/2 inch (9.5 mm) over board or uneven subfloors.
   1. Plywood Underlayment for Resilient Flooring: DOC PS 1, Exposure 1 Underlayment with fully sanded face.
   2. Plywood Underlayment for Carpet: DOC PS 1, Exposure 1, Underlayment with fully sanded face.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Screws for Fastening Sheathing to Wood Framing: ASTM C 1002.

D. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

E. Coordinate with finish flooring requirements for fastener compatibility at underlayment.

F. Use only stainless steel steel screws in coordination with preservative treated wood.

2.6 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
   1. Adhesive shall have a VOC content of 50 g/L or less.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:
   1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
   2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
   3. ICC-ES evaluation report for fastener.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall parapet and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION


B. Fastening Methods: Fasten panels as indicated below:
   1. Combination Subfloor-Underlayment:
      a. Nail to wood framing.
      b. Screw to cold-formed metal framing.
      c. Space panels 1/8 inch (3 mm) apart at edges and ends.
   2. Subflooring:
      a. Nail to wood framing.
      b. Screw to cold-formed metal framing.
      c. Space panels 1/8 inch (3 mm) apart at edges and ends.
3. Roof Sheathing Repair:
   a. Screw to wood framing.
   b. Screw to cold-formed metal framing.
   c. Space panels 1/8 inch (3 mm) apart at edges and ends.

4. Underlayment:
   a. Nail to subflooring.
   b. Space panels 1/32 inch (0.8 mm) apart at edges and ends.
   c. Fill and sand edge joints of underlayment receiving resilient flooring immediately before installing flooring.

3.3 CEMENTITIOUS BACKER UNIT INSTALLATION

   A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

END OF SECTION 06 16 00
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior wood and cellular PVC trim.
2. Lumber soffits.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
2. Section 099000 "Painting" for priming and backpriming of exterior finish carpentry.

1.3 DEFINITIONS

A. MDO: Plywood with a medium-density overlay on the face.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.

2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.

B. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.
C. Samples for Verification:

1. For each species and cut of lumber and panel products, with half of exposed surface finished; 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.
2. For exterior trim, with half of exposed surface finished; 50 sq. in. (300 sq. cm).
3. For moldings, with half of exposed surface finished; 50 sq. in. (300 sq. cm).

1.5 INFORMATIONAL SUBMITTALS

A. Compliance Certificates:

1. For lumber that is not marked with grade stamp.
2. For preservative-treated wood that is not marked with treatment-quality mark.
3. For fire-retardant-treated wood that is not marked with classification marking of testing and inspecting agency.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Composite Wood Trim & Moldings
4. Cellular PVC trim

C. Sample Warranties: For manufacturer's warranties.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.
1. For exterior ornamental wood columns, comply with manufacturer's written instructions and warranty requirements.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.9 WARRANTY

A. Manufacturer's Warranty for Cellular PVC Trim: Manufacturer agrees to repair or replace trim that fails due to defects in manufacturing within specified warranty period. Failures include, but are not limited to, deterioration, delamination, and excessive swelling from moisture.

1. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated.

B. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.

1. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.


2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Water-Repellent Preservative Treatment by Nonpressure Process: AWPA N1; dip, spray, flood, or vacuum-pressure treatment.

1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC).
2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
3. Application: Wood such as blocking in exterior wall / roof assemblies.

B. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC3a.

1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 18 percent, respectively.
2. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
3. For exposed items indicated to receive transparent finish, do not use chemical formulations that contain colorants or that bleed through or otherwise adversely affect finishes.
4. Do not use material that is warped or does not comply with requirements for untreated material.
5. Mark lumber with treatment-quality mark of an inspection agency approved by the American Lumber Standard Committee's Board of Review.
6. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

7. Application: All exterior lumber and plywood.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: For applications indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and comply with testing requirements; testing will be conducted by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Exterior Type: Materials shall comply with testing requirements after being subjected to accelerated weathering according to ASTM D 2898.
2. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.

C. Do not use material that does not comply with requirements for untreated material or is warped or discolored.

D. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

E. Application: Where indicated.

2.4 EXTERIOR WOODWORK

A. Lumber Trim for Painted Finish (Ornamental woodwork & soffits):

1. Species and Grade: Redwood, Grade B; RIS.
2. Maximum Moisture Content: 15 percent.
4. Face Surface: Surfaced (smooth).
5. Factory Priming: Factory coated on faces and edges, with exterior primer compatible with topcoats specified.

B. Moldings for Painted Finish: MMPA WM 4, P-grade wood moldings. Made from kiln-dried stock to patterns included in MMPA's "WM/Series Wood Moulding Patterns."
   1. Species: Redwood.
   2. Finger Jointing: Allowed if made with wet-use adhesive complying with ASTM D 5572.
   3. Factory Priming: Factory coated on faces and edges, with exterior primer compatible with topcoats specified.
   4. Pattern as indicated on drawings.

2.5 EXTERIOR TREATED WOOD COMPOSITE TRIM

A. Exterior Window Trim – profile per drawings

B. Manufacturer:
   1. Manufacturers with product complying with specification includes but not limited to:
      a. Composite “MiraTEC” exterior treated wood composite trim, manufactured by JELD-WEN, inc., 825 Shiner Road, PO Box 311, Towanda, Pennsylvania 18848. Toll Free 800-255-0785. Website www.miratectrim.com. E-mail miratec@jeld-wen.com

C. Material properties
   1. ICC-ES Evaluation Report
   3. Surface: factory primed on 4 sides with low VOC primer containing mildewcide, smooth surface on finish sides.
   4. Substrate: 1 piece solid substrate, uniform density, not laminated, no knots or voids.
   5. Thickness: 5/4 inch, profile as indicated on drawings.

D. Cellular PVC Trim: Extruded, expanded PVC with a small-cell microstructure, recommended by manufacturer for exterior use, made from UV- and heat-stabilized rigid material.
   1. Manufacturers which may provide product complying with specification include but not limited to:
      a. Fypon LTD (Basis of Design)
      b. Azek Building Products
      c. Plasticlad
2. Profiles per drawings for exterior trim
3. Density: Not less than 31 lb/cu. ft. (500 kg/cu. m).
4. Heat Deflection Temperature: Not less than 130 deg F (54 deg C), according to ASTM D 648.
5. Coefficient of Thermal Expansion: Not more than 4.5 x 10(-5) inches/inch x deg F (8.1 x 10(-5) mm/mm x deg C).
6. Water Absorption: Not more than 1 percent, according to ASTM D 570.
7. Flame-Spread Index: 25 or less, according to ASTM E 84.

2.6 LUMBER SOFFITS

A. Provide kiln-dried lumber siding complying with DOC PS 20.
B. Species and Grade: B & B southern pine; SPIB.
C. Pattern: Match existing.

2.7 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.
   1. For face-fastening siding, provide ringed-shank siding nails or hot-dip galvanized-steel siding nails unless otherwise indicated.
   2. For redwood, provide stainless-steel fasteners.
   3. For prefinished items, provide matching prefinished aluminum fasteners where face fastening is required.
   4. For pressure-preservative-treated wood, provide stainless-steel fasteners.
   5. For applications not otherwise indicated, provide hot-dip galvanized-steel fasteners.

B. Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry use.
C. Adhesive for Composite Wood Trim: Product recommended by trim manufacturer.
D. Flashing: Comply with requirements in Section 076200 “Sheet Metal Flashing and Trim” for flashing materials installed in exterior finish carpentry.
E. Sealants: Latex, complying with ASTM C 834 Type OP, Grade NF and applicable requirements in Section 079200 "Joint Sealants" and recommended by sealant and substrate manufacturers for intended application.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. BASF Corporation; Construction Systems.
      b. Bostik, Inc.
      d. Pecora Corporation.
2.8 FABRICATION FOR MILLED TRIM

A. Back out or kerf backs of standing and running trim wider than 5 inches (125 mm), except members with ends exposed in finished work.

B. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed. Cut to required lengths and prime ends. Comply with requirements in Section 099000 "Painting."

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.

1. Do not use manufactured units with defective surfaces, sizes, or patterns.

B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut exterior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.

2. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
3. Coordinate exterior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

A. Install flat-grain lumber with bark side exposed to weather.

B. Install trim to comply with manufacturer’s written instructions.

C. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long, except where necessary.
   1. Use scarf joints for end-to-end joints.
   2. Stagger end joints in adjacent and related members.

D. Fit exterior joints to exclude water. Cope at returns and miter at corners to produce tight-fitting joints, with full-surface contact throughout length of joint. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.

E. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

F. For cellular PVC trim,
   1. Install products in accordance with manufacturer’s instructions, approved submittals, and in proper relationship with adjacent construction.
   2. Use manufacturer’s recommended fasteners, not more than 2 inches from ends.
   3. Glue joints to eliminate joint separation.
   4. Allow for expansion and contraction at ends of the runs

3.5 ADJUSTING

A. Replace exterior finish carpentry that is damaged or does not comply with requirements. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.6 CLEANING

A. Clean exterior finish carpentry on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.7 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062013
SECTION 06 20 23 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
   1. Interior trim, including nonfire-rated interior door and sidelight frames.
   2. Interior trim for glazed wood frames.
   3. Interior plywood and board paneling.
   4. Shelving and clothes rods.

1.3 DEFINITIONS
A. MDF: Medium-density fiberboard.
B. MDO: Plywood with a medium-density overlay on the face.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
   1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
   2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
   3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.

B. Sustainable Design Submittals:
   1. Product Data: For installation adhesives, indicating VOC content.
   2. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.

C. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.
D. Samples for Verification:

1. For each species and cut of lumber and panel products with nonfactory-applied finish, with half of exposed surface finished, 50 square inches (300 square cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.

2. For each finish system and color of lumber and panel products with factory-applied finish, 50 square inches (300 square cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For fire-retardant-treated wood, from ICC-ES.

B. Sample Warranty: For manufacturer's warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

B. Deliver interior finish carpentry materials only when environmental conditions comply with requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions comply with requirements specified for installation areas.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's Board of Review. Grade lumber by an agency certified by the American Lumber Standard Committee's Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by grading agency.

B. Softwood Plywood: DOC PS 1.
C. Hardboard: ANSI A135.4.
D. MDF: ANSI A208.2, Grade 130.
E. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
F. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

1. Color: As selected by Architect from manufacturer's full range.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC1 or UC2.

1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 18 percent, respectively.
2. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
3. For exposed items indicated to receive transparent finish, do not use chemical formulations that contain colorants or that bleed through or otherwise adversely affect finishes.
4. Do not use material that is warped or does not comply with requirements for untreated material.
5. Mark lumber with treatment-quality mark of an inspection agency approved by the American Lumber Standard Committee's Board of Review.
   a. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

6. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
   a. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.

7. Application: Wood in contact with concrete, masonry or blocking within exterior envelope assemblies.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: For applications indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and comply with testing requirements; testing will be conducted by a qualified testing agency.
B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.

C. For exposed items indicated to receive a stained or natural finish, use organic resin chemical formulations that do not contain colorants, and provide materials that do not have marks from spacer sticks on exposed face.

D. Do not use material that does not comply with requirements for untreated material or is warped or discolored.

E. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
2. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.

F. Application: Lumber or Plywood within rated wall assemblies.

2.4 INTERIOR TRIM

A. Softwood Lumber Trim for Transparent Finish (Stain or Clear Finish):
1. Species and Grade: Southern pine, B & B finish; SPIB.
2. Maximum Moisture Content: 19 percent.
4. Face Surface: Surfaced (smooth).

B. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):
1. Species and Grade: White oak, Clear; NHLA.
2. Maximum Moisture Content: 10 percent.
4. Gluing for Width: Use for lumber trim wider than 6 inches (150 mm).
5. Veneered Material: Allowed Use for lumber trim wider than 6 inches (150 mm).
6. Face Surface: Surfaced (smooth).
7. Matching: Selected for compatible grain and color.

C. Lumber Trim for Opaque Finish (Painted Finish):
1. Species and Grade: Poplar, Standard grade.
2. Maximum Moisture Content: 19 percent.
3. Maximum Moisture Content: 10 percent.
5. Face Surface: Surfaced (smooth).
6. Optional Material: Primed MDF of same actual dimensions as lumber indicated may be used in lieu of lumber.
D. Wood Moldings for Transparent Finish (Stain or Clear Finish): MMPA WM 4, N-grade wood moldings. Made to patterns included in MMPA's "WM/Series Wood Moulding Patterns."

1. Species: White Oak.
2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
4. Matching: Selected for compatible grain and color.

E. Moldings for Opaque Finish (Painted Finish): Made to patterns included in MMPA's "WM/Series Wood Moulding Patterns."

   a. Species: Poplar.
   b. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
2. Optional Material: Primed MDF.

2.5 PANELING

A. Hardwood Veneer Plywood Paneling: Manufacturer's stock hardwood plywood panels complying with HPVA HP-1.

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. [Chesapeake Hardwood Products, Inc.](#)
   b. [Georgia-Pacific Building Products.](#)
   c. [Holland Southwest International.](#)

2. Face Veneer Species and Cut: Rift cut White Oak.

3. Veneer Matching: Selected for similar color and grain.
5. Construction: Veneer core.
6. Thickness: As shown on Drawings.
7. Panel Size: As shown on Drawings.
8. Glue Bond: Type II (interior).
9. Finish: As selected by Architect from manufacturer's full range.

B. Board Paneling: Interior wood-board paneling complying with MMPA WM 9.

1. Species: Poplar.
2. Grade: Standard grade.
3. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
2.6  SHELVING AND CLOTHES RODS

A. Utility Shelving: Made from any of the following material, 3/4 inch (19 mm) thick.
   1. Particleboard with solid-wood front edge.
   2. MDF with solid-wood front edge.
   3. MDO softwood plywood with solid-wood edge.
   4. Melamine-faced particleboard with applied-PVC front edge.
   5. Wood boards as specified above for lumber trim for opaque finish.

B. Shelf Cleats: 3/4-by-3-1/2-inch (19-by-89-mm) boards, as specified above for lumber trim for opaque finish.

C. Clothes Rods: 1-1/2-inch- (38-mm-) diameter, clear, kiln-dried hardwood.

D. Rod Flanges: Stainless steel.

2.7  MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

B. Low-Emitting Materials: Adhesives shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
   1. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
   2. Adhesives shall have a VOC content of [30] <Insert value> g/L or less.
   3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Paneling Adhesive: Comply with paneling manufacturer's written recommendations for adhesives.
   1. Adhesives shall have a VOC content of [50] <Insert value> g/L or less.
   2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer.
1. **Adhesives shall have a VOC** content of \([70]\) \(<\text{Insert value} > \) g/L or less.
2. **Adhesive shall comply with the** testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.8 **FABRICATION**

A. Back out or kerf backs of the following members, except those with ends exposed in finished work:
   1. Interior standing and running trim, except shoe and crown molds.
   2. Wood-board paneling.

   B. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

**PART 3 - EXECUTION**

3.1 **EXAMINATION**

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 **PREPARATION**

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.3 **INSTALLATION, GENERAL**

A. Do not use materials that are unsound; warped; improperly treated or finished; inadequately seasoned; too small to fabricate with proper jointing arrangements; or with defective surfaces, sizes, or patterns.

B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

   1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
   2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
3. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.

4. Install stairs with no more than 3/16-inch (4.7-mm) variation between adjacent treads and risers and with no more than 3/8-inch (9.5-mm) variation between largest and smallest treads and risers within each flight.

5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long, except where necessary. Stagger joints in adjacent and related standing and running trim. Cope at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.

1. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
2. Install trim after gypsum-board joint finishing operations are completed.
3. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 PANELING INSTALLATION

A. Plywood Paneling: Select and arrange panels on each wall to minimize noticeable variations in grain character and color between adjacent panels. Leave 1/4-inch (6-mm) gap to be covered with trim at top, bottom, and openings. Install with uniform tight joints between panels.

1. Attach panels to supports with manufacturer's recommended panel adhesive and fasteners. Space fasteners and adhesive as recommended by panel manufacturer.
2. Conceal fasteners to greatest practical extent.
3. Arrange panels with grooves and joints over supports. Fasten to supports with nails of type and at spacing recommended by panel manufacturer. Use fasteners with prefinished heads matching groove color.

B. Hardboard Paneling: Install according to manufacturer's written recommendations. Leave 1/4-inch (6-mm) gap to be covered with trim at top, bottom, and openings. Butt adjacent panels with moderate contact. Use fasteners with prefinished heads matching paneling color.

1. Wood Stud or Furring Substrate: Install with 1-inch (25-mm) annular-ring shank hardboard nails.
2. Plaster or Gypsum-Board Substrate: Install with 1-5/8-inch (41-mm) annular-ring shank hardboard nails.
3. Nailing: Space nails 4 inches (100 mm) o.c. at panel perimeter and 8 inches (200 mm) o.c. at intermediate supports unless otherwise required by manufacturer.

C. Board Paneling: Install according to manufacturer's written instructions. Arrange in random-width pattern suggested by manufacturer unless boards or planks are of uniform width.
1. Install in full lengths without end joints.
2. Stagger end joints in random pattern to uniformly distribute joints on each wall.
3. Install with uniform end joints with only end-matched (tongue-and-groove) joints within each field of paneling.
4. Install with uniform end joints. Locate end joints only over furring or blocking.
5. Select and arrange boards on each wall to minimize noticeable variations in grain character and color between adjacent boards. Install with uniform tight joints between boards.
6. Fasten paneling by face nailing, setting nails, and filling over nail heads.
7. Fasten paneling with trim screws, set below face and filled.
8. Fasten paneling by blind nailing through tongues.
9. Fasten paneling with paneling system manufacturer's concealed clips.
10. Fasten paneling to gypsum wallboard with panel adhesive.

3.6 SHELVING AND CLOTHES ROD INSTALLATION

A. Cut shelf cleats at ends of shelves about 1/2 inch (13 mm) less than width of shelves and sand exposed ends smooth.

B. Install shelf cleats by fastening to framing or backing with finish nails or trim screws, set below face and filled. Space fasteners not more than 16 inches (400 mm) o.c. Use two fasteners at each framing member or fastener location for cleats 4 inches nominal (89 mm actual) in width and wider.

1. Apply a bead of multipurpose construction adhesive to back of shelf cleats before installing. Remove adhesive that is squeezed out after fastening shelf cleats in place.

C. Install shelf brackets according to manufacturer's written instructions, spaced not more than 32 inches (800 mm) o.c. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

D. Install standards for adjustable shelf supports according to manufacturer's written instructions. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Space fasteners not more than 12 inches (300 mm) o.c.

E. Install standards for adjustable shelf brackets according to manufacturer's written instructions, spaced not more than 36 inches (900 mm) o.c. and within 6 inches (150 mm) of ends of shelves. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

F. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled. Install shelves, fully seated on cleats, brackets, and supports.

1. Fasten shelves to cleats with finish nails or trim screws, set flush.
2. Fasten shelves to brackets to comply with bracket manufacturer's written instructions.

G. Install rod flanges for rods as indicated. Fasten to shelf cleats, framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Install rods in rod flanges.
3.7 ADJUSTING

A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.8 CLEANING

A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes if any.

3.9 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062023
SECTION 06 41 16 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

B. Related Requirements:

1. Section 061000 “Rough Carpentry” for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
2. Section 123661.19 “Quartz Agglomerate Countertops.”

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Sustainable Design Submittals:

1. **Product Data**: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. **Product Certificates**: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
3. **Product Data**: For adhesives, indicating that product contains no urea formaldehyde.
4. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
5. **Product Data**: For composite wood products, indicating that product contains no urea formaldehyde.
6. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate cabinets.

D. Samples for Initial Selection:

1. Plastic laminates.
2. PVC edge material.
3. Thermoset decorative panels.

E. Samples for Verification:

1. Plastic laminates, 8 by 10 inches (200 by 250 mm), for each color, pattern, and surface finish, with one sample applied to core material and specified edge material applied to one edge.
2. Wood-grain plastic laminates, 12 by 24 inches (300 by 600 mm), for each type, pattern and surface finish, with one sample applied to core material and specified edge material applied to one edge.
3. Thermoset decorative panels, 8 by 10 inches (200 by 250 mm), for each color, pattern, and surface finish, with edge banding on one edge.
4. Corner pieces as follows:
   a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches (450 mm) high by 18 inches (450 mm) wide by 6 inches (150 mm) deep.
   b. Miter joints for standing trim.

5. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Product Certificates: For each type of product the following:

1. Composite wood and agrifiber products.
2. Thermoset decorative panels.
3. High-pressure decorative laminate.
4. Glass.
5. Adhesives.

C. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.
1.6 QUALITY ASSURANCE

A. Fabricator and Installer Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during the remainder of the construction period.

C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Field Measurements: Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

2. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087111 "Door Hardware (Descriptive Specification)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.
PART 2 - PRODUCTS

2.1  PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
   1. Provide labels from certification program indicating that woodwork complies with requirements of grades specified.
   2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Grade: Premium.

C. Regional Materials: Wood products shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

D. Regional Materials: Wood products shall be manufactured within 500 miles (800 km) of Project site.

E. Type of Construction: Frameless.

F. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.

G. Reveal Dimension: 1/8 inch.

H. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Abet Laminati Inc.
      b. Formica Corporation.
      c. Lamin-Art, Inc.
      d. Pionite; a Panolam Industries International, Inc. brand.
      e. Wilsonart.

I. Laminate Cladding for Exposed Surfaces:
   1. Horizontal Surfaces: Grade HGS.
   2. Postformed Surfaces: Grade HGP.
   3. Vertical Surfaces: Grade VGS.
   4. Edges: PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.
   5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

J. Materials for Semiexposed Surfaces:
   1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.
b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
c. For semipexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, [Grade VGS] [Grade CLS].

2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
3. Drawer Bottoms: Thermoset decorative panels.

K. Dust Panels: 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers unless located directly under tops.

L. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

M. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued dovetail joints.

N. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations.
3. As selected by Architect from laminate manufacturer's full range in the following categories:
   a. Solid colors, matte finish.
   b. Solid colors with core same color as surface, matte finish.
   c. Wood grains, matte finish.
   d. Patterns, matte finish.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 8 to 13 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Recycled Content of MDF and Particleboard: Disclose Postconsumer recycled content plus one-half of preconsumer recycled content.

C. Composite Wood Products: Products shall be made without urea formaldehyde.

D. Composite Wood Products: Products shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) Environ Biocomposites Manufacturing LLC.
      2) Sorm Incorporated.
      3) Roseburg Forest Products Co.
4. Softwood Plywood: DOC PS 1, medium-density overlay.
6. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
   1. Use treated materials that comply with requirements of referenced woodworking standard. Do not use materials that are warped, discolored, or otherwise defective.
   2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
   3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
   1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
   2. For items indicated to receive a stained or natural finish, use organic resin chemical formulation.
   3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
   4. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.

C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
1. For panels 3/4 inch (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi (11 MPa); modulus of elasticity, 300,000 psi (2070 MPa); internal bond, 80 psi (550 kPa); and screw-holding capacity on face and edge, 250 and 225 lbf (1100 and 1000 N), respectively.

2. For panels 13/16 to 1-1/4 inches (20 to 32 mm) thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi (9 MPa); modulus of elasticity, 250,000 psi (1720 MPa); linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf (1100 and 780 N), respectively.

D. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.

2.4 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087111 "Door Hardware (Descriptive Specification)."

B. Butt Hinges: 2-3/4-inch (70-mm), five-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as follows:

1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.

D. Back-Mounted Pulls: BHMA A156.9, B02011.

E. Rod Pulls (Typical unless noted otherwise): Back mounted, solid metal, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter.

F. Catches: Magnetic catches, BHMA A156.9, B03141.

G. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

H. Shelf Rests: BHMA A156.9, B04013; metal.

I. Drawer Slides: BHMA A156.9.

1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; type; with polymer rollers.
2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
3. For drawers not more than 3 inches (75 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1.
4. For drawers more than 3 inches (75 mm) high but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1HD-100.
5. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide Grade 1HD-200.
6. For computer keyboard shelves, provide Grade 1HD-100.
7. For trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide, provide Grade 1HD-200.

J. Aluminum Slides for Sliding Glass Doors: BHMA A156.9, B07063.

K. Door Locks: BHMA A156.11, E07121.

L. Drawer Locks: BHMA A156.11, E07041.

M. Door and Drawer Silencers: BHMA A156.16, L03011.

N. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base; match Architect's sample.
2. Bright Brass, Clear Coated: BHMA 605 for brass base; BHMA 632 for steel base.
5. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
6. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
7. Satin Stainless Steel: BHMA 630.

O. For concealed hardware, provide manufacturer’s standard finish that complies with product class requirements in BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. **Adhesives**: Do not use adhesives that contain urea formaldehyde.

D. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Adhesive for Bonding Plastic Laminate: woodworker's option

2.6 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate cabinets to dimensions, profiles, and details indicated.
C. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

D. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

E. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

1. Use filler matching finish of items being installed.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.

2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 06 41 16
SECTION 06 48 00 - WOOD FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Interior frames and jambs.
   2. Shop priming wood frames and jambs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including fire-retardant-treated materials and finishing materials and processes.
   1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
   2. Product Data: For adhesives, indicating that product contains no urea formaldehyde.
   3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
   1. Show details full size.
   2. Show locations and sizes of concealed blocking and reinforcement specified in other Sections.

C. Samples for Verification:
   1. Lumber not less than 5 inches (125 mm) wide by 12 inches (300 mm) long, for each species and cut, finished on one side and one edge.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer and fabricator.

B. Product Certificates: For each type of product.
1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockups of typical wood frames as shown on Drawings.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver wood frames until operations that could damage wood frames have been completed in installation areas. If wood frames must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

A. Environmental Limitations for Interior Work: Do not deliver or install interior wood frames until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations for Interior Work: Do not deliver or install interior wood frames until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where wood frames are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support wood frames by field measurements before being enclosed, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where wood frames are indicated to fit to other construction, establish dimensions for areas where wood frames are to fit. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that wood frames can be supported and installed as indicated.
PART 2 - PRODUCTS

2.1 WOOD FRAMES, GENERAL
   A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of wood frames indicated for construction, finishes, installation, and other requirements.

2.2 INTERIOR FRAMES AND JAMBS FOR TRANSPARENT FINISH
   A. Grade: Premium.
   B. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.
      2. Cut: Rift cut/rift sawn.
      3. Provide split species on frames and jambs that face areas with different wood species or different finishes, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.
   C. For frames or jambs wider than available lumber, use veneered construction. Do not glue for width.
   D. Refer to Finish Schedule for locations.

2.3 INTERIOR FRAMES AND JAMBS FOR OPAQUE FINISH
   A. Grade: Economy.
   B. Wood Species: Poplar.
   C. Refer to Finish Schedule for locations.

2.4 WOOD MATERIALS
   A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of wood frame and quality grade specified unless otherwise indicated.
      1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches wide.
      2. Wood Moisture Content for Exterior Materials: 9 to 15 percent.
      3. Wood Moisture Content for Interior Materials: 5 to 10 percent.

2.5 MISCELLANEOUS MATERIALS
   A. Interior Blocking, Shims, and Nailers: Softwood or hardwood lumber Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
   B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.
C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

D. Adhesives: Do not use adhesives that contain urea formaldehyde.

2.6 FABRICATION

A. Fabricate wood frames to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.

2.7 SHOP PRIMING

A. Interior Wood Frames for Opaque Finish: Shop prime with one coat of wood primer specified in Section 09 91 00 "Painting."

B. Interior Wood Frames for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 09 93 00 "Staining and Transparent Finishing."

C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood frames, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood trim. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

2.8 SHOP FINISHING

A. General: Finish wood frames at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. General: Shop finish transparent-finished wood frames at fabrication shop as specified in this Section. Refer to Section 09 91 00 "Painting" for field finishing opaque-finished wood frames.

C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood frames, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood frames. Apply two coats to end-grain surfaces.

D. Transparent Finish for Interior Frames: Comply with Section 09 93 00 "Staining and Transparent Finishing."

E. Opaque Finish for Interior Frames: Comply with Section 09 91 00 "Painting."
PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition wood frames to average prevailing humidity conditions in installation areas.

B. Before installing wood frames, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install wood frames to comply with same grade as item to be installed.

B. Assemble wood frames and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install wood frames level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut wood frames to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor wood frames to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

1. For shop-finished items, use filler matching finish of items being installed.

F. Touch up finishing work specified in this Section after installation of wood frames. Fill nail holes with matching filler where exposed.

1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.

G. Refer to Section 099100 “Painting” and for final finishing of installed wood frames not indicated to be shop finished.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective wood frames, where possible, to eliminate functional and visual defects; where not possible to repair, replace wood frames. Adjust joinery for uniform appearance.

B. Clean wood frames on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06 48 00
SECTION 07 01 50.19 - PREPARATION FOR REROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
   1. Full tear-off of roof areas indicated.
   2. Partial tear-off of roof areas indicated.
   3. Temporary roofing.
B. Related Requirements:
   1. Section 011000 "Summary" for use of the premises and phasing requirements.
   2. Section 015000 "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for reroofing preparation.

1.3 UNIT PRICES
A. Work of this Section is affected by roofing removal and replacement unit price.

1.4 DEFINITIONS
A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.
B. Roof Re-Cover Preparation: Existing roofing system is to remain and be prepared for new roof installed over it.
C. Full Roof Tear-Off: Removal of existing roofing system from deck.
D. Partial Roof Tear-Off: Removal of selected components and accessories from existing roofing system.

1.5 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: Include plans, sections, and details.
C. Temporary Roofing Submittal: Product data and description of temporary roofing system. If temporary roof remains in place, include surface preparation requirements needed to receive permanent roof, and submit a letter from roofing manufacturer, stating acceptance of the temporary roof and that its inclusion does not adversely affect the roofing system's resistance to fire and wind.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
   1. Include certificate that Installer is approved by warrantor of existing roofing system.
   2. Include certificate that Installer is licensed to perform asbestos abatement.

B. Fastener pull-out test report.

C. Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces, that might be misconstrued as having been damaged by reroofing operations. Submit before Work begins.

D. Landfill Records: Indicate receipt and acceptance of demolished roofing materials and hazardous wastes, such as asbestos-containing materials, by a landfill facility licensed to accept them.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 10 years experience in roofing similar projects.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning roofing removal. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Reroofing Conference: Conduct conference at Project site.
   1. Meet with Owner; Architect; Owner's insurer if applicable; testing and inspecting agency representative; roofing system manufacturer's representative; roofing Installer, including project manager, superintendent, and foreman; and installers whose work interfaces with or affects reroofing, including installers of roof deck, roof accessories, and roof-mounted equipment.
   2. Review methods and procedures related to roofing system tear-off and replacement, including, but not limited to, the following:
      a. Reroofing preparation, including roofing system manufacturer's written instructions.
      b. Temporary protection requirements for existing roofing system components that are to remain.
      c. Existing roof drains and roof drainage during each stage of reroofing, and roof-drain plugging and plug removal.
      d. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to avoid delays.
      e. Existing roof deck conditions requiring notification of Architect.
      f. Existing roof deck removal procedures and Owner notifications.
      g. Condition and acceptance of existing roof deck and base flashing substrate for reuse.
      h. Structural loading limitations of roof deck during reroofing.
i. Base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that affect reroofing.

j. HVAC shutdown and sealing of air intakes.
k. Shutdown of fire-suppression, -protection, and -alarm and -detection systems.
l. Asbestos removal and discovery of asbestos-containing materials.
m. Governing regulations and requirements for insurance and certificates if applicable.
n. Existing conditions that may require notification of Architect before proceeding.

1.8 FIELD CONDITIONS

A. Existing Roofing System: EPDM roofing where indicated. Existing slate tile roof where indicated.

B. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.

C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

D. Conditions existing at time of inspection for bidding are maintained by Owner as far as practical.

1. A wood deck survey of existing conditions from below is available for Contractor's reference. This report is intended to supplement rather than serve in lieu of Contractor's own investigations. Contractor is responsible for conclusions derived from existing documents.

E. Limit construction loads on roof to avoid damage to existing roofing and deck in accordance with owner's existing warranty requirements at membrane area and to avoid damage at slate roof area.

F. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.

1. Remove only as much roofing in one day as can be made watertight in the same day.

G. Hazardous Materials: A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except according to procedures specified elsewhere in the Contract Documents.
3. Coordinate reroofing preparation with hazardous material remediation to prevent water from entering existing roofing system or building.

1.9 WARRANTY

A. Existing Warranties: At existing membrane roof, remove, replace, patch, and repair materials and surfaces cut or damaged during reroofing, by methods and with materials so as not to void existing roofing system warranty. Notify warrantor before proceeding.

1. Notify warrantor of existing roofing system on completion of reroofing, and obtain documentation verifying that existing roofing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.
PART 2 - PRODUCTS

2.1 TEMPORARY PROTECTION MATERIALS

A. Expanded Polystyrene (EPS) Insulation: ASTM C 578.

B. Plywood: DOC PS1, Grade CD Exposure 1.

C. OSB: DOC PS2, Exposure 1.

2.2 TEMPORARY ROOFING MATERIALS

A. Design and selection of materials for temporary roofing are Contractor's responsibilities.

B. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).

C. Base Sheet: ASTM D 4601, Type II, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet.

D. Glass-Fiber Felts: ASTM D 2178, Type IV, asphalt-impregnated, glass-fiber felt.

E. Asphalt Primer: ASTM D 41/D 41M.

F. Roofing Asphalt: ASTM D 312, Type III or IV.

G. Base Sheet Fasteners: Capped head, factory-coated steel fasteners, listed in FM Global's "Approval Guide."

2.3 INFILL AND REPLACEMENT MATERIALS

A. Use infill materials matching existing roofing system materials unless otherwise indicated.

2.4 AUXILIARY REROOFING MATERIALS

A. General: Use auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of existing roofing system.

PART 3 - EXECUTION

3.1 PREPARATION

A. Shut off rooftop utilities and service piping before beginning the Work.

B. Test existing roof drains to verify that they are not blocked or restricted. Immediately notify Architect of any blockages or restrictions.

C. Protect existing roofing system that is not to be reroofed.
D. At membrane areas:
1. Loosely lay 1-inch (25-mm-) minimum thick, expanded polystyrene (EPS) insulation over existing roofing in areas indicated. Loosely lay 15/32-inch (12-mm) plywood or OSB panels over EPS. Extend EPS past edges of plywood or OSB panels a minimum of 1 inch (25 mm).
2. Limit traffic and material storage to areas of existing roofing that have been protected.
3. Maintain temporary protection and leave in place until replacement roofing has been completed. Remove temporary protection on completion of reroofing.

E. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.

F. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday. Prevent debris from entering or blocking roof drains and conductors. Use roof-drain plugs specifically designed for this purpose. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
1. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new roofing system, provide alternative drainage method to remove water and eliminate ponding. Do not permit water to enter into or under existing roofing system components that are to remain.

3.2 ROOF TEAR-OFF
A. Partial Roof Tear-Off: Where indicated, remove existing roofing and immediately check for presence of moisture by visually observing substrate that is to remain.
1. Coordinate with Owner's inspector to schedule times for tests and inspections immediately after removal.
2. With an electrical capacitance moisture-detection meter, spot check substrate that is to remain.
3. Inspect and notify architect of areas of wet roof blocking, curbs, and/or nailers. Removal and replacement is paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.
4. **Salvage existing slate tiles for reuse where tile is in good and reusable condition.**
5. Remove fasteners from deck.

3.3 DECK PREPARATION
A. Inspect deck after tear-off of roofing system.
B. If broken or loose fasteners that secure deck panels to one another or to structure are observed, or if deck appears or feels inadequately attached, immediately notify Architect. Do not proceed with installation until directed by Architect.
C. If deck surface is unsuitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect. Do not proceed with installation until directed by Architect.
D. Replace damaged decking as indicated on Drawings (see structural in addition to architectural)
E. Replace roof decking as directed by Architect. Roof decking replacement will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

3.4 TEMPORARY ROOFING

A. Install approved temporary roofing over area to be reroofed.

B. Install temporary roofing over area to be reroofed. Install two glass-fiber felts, lapping each sheet 19 inches (483 mm) over preceding sheet.

C. Remove temporary roofing before installing new roofing.

3.5 BASE FLASHING REMOVAL

A. Remove existing base flashings. Clean substrates of contaminants, such as asphalt, sheet materials, dirt, and debris.

B. Do not damage metal counterflashings that are to remain. Replace metal counterflashings damaged during removal with counterflashings of same metal, weight or thickness, and finish.

C. Inspect parapet sheathing, wood blocking, curbs, and nailers for deterioration and damage. If parapet sheathing, wood blocking, curbs, or nailers have deteriorated, immediately notify Architect.

D. When directed by Architect, replace wood blocking, curbs, and nailers with new like materials.

3.6 DISPOSAL

A. Collect demolished materials and place in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

   1. Storage or sale of demolished items or materials on-site is not permitted.

B. Transport and legally dispose of demolished materials off Owner's property.

END OF SECTION 07 01 50.19
SECTION 07 14 16 - COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyurethane waterproofing, horizontal systems.
2. Waterproof Expansion Joints

B. Related Sections:

1. Section 00 61 43 Three Year Roof Bond.
2. Section 07 17 00 – Bentonite Waterproofing (for vertical waterproofing assemblies)
3. Section 07 50 35 – Roof Warranty Execution
4. Section 07 50 36 – Roof Warranty

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review waterproofing requirements including, but not limited to, the following:
   a. Surface preparation specified in other Sections.
   b. Minimum curing period.
   c. Forecasted weather conditions.
   d. Special details and sheet flashings.
   e. Repairs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer’s written instructions for evaluating, preparing, and treating substrate.

B. Shop Drawings:

1. Show locations and extent of waterproofing.
2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
3. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.
C. Samples: For each exposed product and for each color and texture specified, including the following products:

1. Flashing sheet, 8 by 8 inches (200 by 200 mm).
2. Membrane-reinforcing fabric, 8 by 8 inches (200 by 200 mm).
3. Insulation, 8 by 8 inches (200 by 200 mm).
4. Drainage panel, 4 by 4 inches (100 by 100 mm).

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Field quality-control reports.
C. Warranty

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer and as required by manufacturer to provide warranty listed.
B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.
   1. Build mockup for each typical waterproofing installation including accessories to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, and protection.
      a. Size: 100 sq. ft. (9.3 sq. m) in area.
      b. Description: Each type of wall, deck, and plaza installation.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer.
   1. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
   2. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.
B. Maintain adequate ventilation during application and curing of waterproofing materials.
1.7 WARRANTY

A. Provide warranty in accordance with Tennessee Board of Regents Warranty requirements as indicated in sections 075035 Roof Warranty Execution and 075036 Roof Warranty.

1. Warranty Period: 30 years from date of Substantial Completion. Warranty includes materials and labor.

2. Contractor shall provide roof bond on work related to this section in accordance with 00 61 43 Three Year Roof Bond.

1.8 Schedule

1. Horizontal Waterproofing Assembly: (interior side to exposed side) (also referred to as ‘Plaza Deck” and/or “split slab” plaza)
   a. Surface Preparation as required for surface (primers and/or mechanical preparation)
   b. Polyurethane Waterproofing and auxiliary materials
   c. Reinforcing Membrane
   d. Protection Course
   e. Drainage Panel
   f. High load insulation (4” thickness)

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations for Waterproofing System: Obtain waterproofing materials, protection course, and molded-sheet drainage panels from single source from single manufacturer.

2.2 SINGLE-COMPONENT POLYURETHANE WATERPROOFING


1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Carlisle Coatings & Waterproofing Inc. (Basis of Design: CCW Mira Seal Plaza Deck System)
   b. BASF Corporation; Construction Systems
   c. Tremco Incorporated

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials recommended in writing by waterproofing manufacturer for intended use and compatible with one another and with waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
B. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated acrylic latex, polyurethane, or epoxy.

C. Sheet Flashing: 50-mil- (1.3-mm-) minimum, nonstaining, uncured sheet neoprene.
   1. Adhesive: Manufacturer's recommended contact adhesive.

D. Membrane-Reinforcing Fabric: Manufacturer's recommended fiberglass mesh or polyester fabric, manufacturer's standard weight.

E. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.

F. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing; ASTM C 920, Type M, Class 25 or greater; Grade NS for sloping and vertical applications and Grade P for deck applications; Use NT exposure; and as recommended by manufacturer for substrate and joint conditions.
   1. Backer Rod: Closed-cell polyethylene foam.

2.4 PROTECTION COURSE

A. Protection Course at vertical application: Fan folded, with a core of extruded-polystyrene board insulation faced on one side with plastic film, nominal thickness of 1/4 inch (6 mm), with compressive strength of not less than 8 psi (55 kPa) according to ASTM D 1621 and maximum water absorption by volume of 0.6 percent according to ASTM C 272.

   1. Manufacturers: Subject to compliance with requirements and approval by waterproofing manufacturer, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Carlisle Coatings & Waterproofing Inc.
      b. Dow Chemical Company
      c. Owens Corning

B. Protection Course at horizontal application: nonwoven polypropylene protection fabric to cushion and protect the waterproofing membrane. Puncture resistance per ASTM D4833 of 235 lbs. As manufactured by the waterproofing manufacturer or as approved for use in warranted system by waterproofing manufacturer.

2.5 MOLDED-SHEET DRAINAGE PANELS

A. Vertical Applications: Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate of 9 to 18 gpm per ft. (112 to 220 L/min. per m).

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Hydrotech, Inc.
      b. BASF Corporation; Construction Systems.
c. **Carlisle Coatings & Waterproofing Inc.**
d. **Polyguard Products, Inc.**

B. **Plaza Deck Applications: Woven-Geotextile-Faced, Molded-Sheet Drainage Panel:** Composite subsurface drainage panels consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.43-mm) sieve, laminated to one side of the core, without a polymeric film bonded to the other side; and with a horizontal flow rate of not less than 2.8 gpm per ft. (35 L/min. per m).

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. **American Hydrotech, Inc.**
   b. **BASF Corporation: Construction Systems.**
   c. **Carlisle Coatings & Waterproofing Inc.**
   d. **Polyguard Products, Inc.**

C. **Molded-Sheet Collector-Panel System:** Composite subsurface collector-panel system by same manufacturer as primary molded-sheet drainage panels; consisting of a high-profile, studded, nonbiodegradable, molded-plastic-sheet drainage core; with a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.425-mm) sieve laminated to one side of the core, without a polymeric film bonded to the other side; and with a vertical flow rate of at least 15 gpm per ft. (112 to 188 L/min. per m) and a horizontal flow rate of 3 gpm per foot. Provide system with manufacturer's outlets, connectors, tapes, and other accessories to connect primary molded-sheet drainage panels with piped subdrainage system shown on Civil drawings.
   a. Same manufacturer as Molded-Sheet Drainage Panel above, part of system.

2.6 **INSULATION**

A. **At Plaza Deck System (horizontal application) - Board Insulation:** Extruded-polystyrene board insulation according to ASTM C 578, square edged, 4 inch thickness

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. **Dow Chemical Company (The).**
   b. **Kingspan Insulation.**
   c. **Owens Corning.**

2. Type VII, 60-psi (414-kPa) minimum compressive strength.

2.7 **WATERPROOF EXPANSION JOINTS**

A. **At Plaza Deck System (horizontal application) – 1/2-inch wide Waterproof Expansion Joint with preformed sealant.** Preformed sealant shall be silicone pre-coated, preformed, pre-compressed, self-expanding, sealant system.

1. **Basis of Design Product:** Provide DSM as manufactured by EMSEAL JOINT SYSTEMS, LTD 25 Bridle Lane, Westborough, MA 01581-2603, Toll Free: 800-526-8365 and as indicated on Drawings for horizontal-plane expansion joint locations.
a. Alternate manufacturers must demonstrate that their products meet or exceed the design criteria and must submit certified performance test reports performed by nationally recognized independent laboratories as called for in Submittals. Submittal of alternates must be made three weeks prior to bid opening to allow proper evaluation time.

2. Provide traffic durable, watertight, expansion joint by EMSEAL Joint Systems for expansion joints and isolation joints in decks. Typical locations include, but are not limited to the following: applications for joints over occupied space, below-grade, stair tower perimeters, elevator perimeters, stadium tread and risers, parking deck joints, treatment plant perimeters and covers, ice-floor perimeter joints, and structural expansion joints. System shall perform waterproofing, traffic bearing and movement-accommodation functions as the result of a single installation and without the addition of gutters, vapor barriers, bladders, or other devices suspended beneath or within the system in any way.

3. Sealant system shall be comprised of three components: 1) cellular polyurethane foam impregnated with hydrophobic 100% acrylic, water-based emulsion, factory coated with high-grade, fuel resistant silicone; 2) field-applied epoxy adhesive primer, 3) field-injected silicone sealant bands.

4. Provide Material shall be capable of movements of +50%, -50% (100%) total of nominal material size.

5. Silicone coating to be high-grade, low-modulus, jet-fuel resistant silicone applied to the impregnated foam sealant at a width greater than maximum allowable joint extension and which when cured and compressed will form a bellows.

6. DSM to be installed into manufacturer’s standard field-applied epoxy adhesive.

7. DSM to be installed slightly recessed from the surface such that when the field-applied injection band of silicone is installed between the substrates and the foam-and-silicone-bellows, the system will be essentially flush with the substrate surface.

8. Select the sealant system model appropriate to the movement and design requirements at each joint location that meet the project specification or as defined by the structural engineer of record.

9. Manufacturer’s Checklist must be completed by expansion joint subcontractor and returned to manufacturer at time of ordering material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.

2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer’s written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.

E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

F. At existing masonry surfaces, provide tuck pointing to achieve substrate uniformity per waterproofing manufacturer’s recommendations and requirements.

3.3 PREPARATION AT TERMINATIONS, PENETRATIONS, AND CORNERS

A. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners according to waterproofing manufacturer’s written instructions and to recommendations in ASTM C 898/C 898M and ASTM C 1471.

B. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrate according to waterproofing manufacturer’s written instructions and to recommendations in ASTM C 898/C 898M and ASTM C 1471. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.


2. Apply bond breaker on sealant surface, beneath preparation strip.

3. Prime substrate along each side of joint and apply a single thickness of preparation strip at least 6 inches (150 mm) wide along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.

B. Install sheet flashing and bond to deck and wall substrates where required according to waterproofing manufacturer’s written instructions.

1. Extend sheet flashings for 8 inches onto perpendicular surfaces and items penetrating substrate.

3.5 WATERPROOFING APPLICATION

A. Apply waterproofing according to manufacturer’s written instructions and to recommendations in ASTM C 898/C 898M and ASTM C 1471.
B. Start installing waterproofing in presence of manufacturer's technical representative.

C. Apply primer over prepared substrate unless otherwise instructed in writing by waterproofing manufacturer.

D. Reinforced Waterproofing Applications: Mix materials and apply waterproofing by roller, notched squeegee, trowel, or other suitable application method.
   1. Apply first coat of waterproofing, embed membrane-reinforcing fabric, and apply second coat of waterproofing to completely saturate reinforcing fabric and to obtain a seamless reinforced membrane free of entrapped gases and pinholes, with an average dry film total thickness of 120 mils (3 mm).
   2. Apply reinforced waterproofing to prepared wall terminations and vertical surfaces.
   3. Verify manufacturer’s recommended wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).

E. Cure waterproofing, taking care to prevent contamination and damage during application and curing.

F. Install protection course with butted joints over waterproofing before starting subsequent construction operations.
   1. For horizontal applications, install protection course loose laid over fully cured membrane.
   2. For vertical applications, set protection course in nominally cured membrane, which will act as an adhesive. If membrane cures before application of protection course, use adhesive.

3.6 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
   1. For vertical applications, install protection course before installing drainage panels.

B. Molded-Sheet Collector-Panel System: Install according to manufacturer's written instructions. Connect to piped subdrainage system shown on Civil drawings.

3.7 INSULATION INSTALLATION

A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.

B. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions.

C. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
3.8 INSULATION DRAINAGE PANEL INSTALLATION

A. Install drainage panels over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.

B. Ensure that drainage channels are aligned and free of obstructions.

C. On vertical surfaces, set insulation drainage panels in adhesive or tape applied according to manufacturer’s written instructions.

D. On horizontal surfaces, loosely lay insulation drainage panels according to manufacturer’s written instructions. Stagger end joints and tightly abut insulation units.

3.9 WATERPROOF EXPANSION JOINT INSTALLATION

A. Preparation of the Work Area

1. The contractor shall provide properly formed and prepared expansion joint openings constructed to the exact dimensions and elevations shown on manufacturer’s standard system drawings or as shown on the contract drawings. Deviations from these dimensions will not be allowed without the written consent of the engineer of record.

2. The contractor shall clean the joint opening of all contaminants immediately prior to installation of expansion joint system. Repair spalled, irregular or unsound joint surfaces using accepted industry practices for repair of the substrates in question. Remove protruding roughness to ensure joint sides are smooth. Ensure that there is sufficient depth to receive the full depth of the size of the DSM being installed. Refer to Manufacturers Installation Guide for detailed step-by-step instructions.

3. No drilling, or screwing, or fasteners of any type are permitted to anchor the sealant system into the substrate.

4. System to be installed by qualified sub-contractors only according to detailed published installation procedures and/or in accordance with job-specific installation instructions of manufacturer’s field technician.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage Engage a qualified testing agency to perform tests and inspections:

1. Testing agency shall verify thickness of waterproofing during application for each 600 sq. ft. (56 sq. m) of installed waterproofing or part thereof.

2. Electronic Leak-Detection Testing – refer to Section 07 72 72 Membrane Leak Detection System

   a. Testing agency shall test each deck area for leaks using an electronic leak-detection method that locates discontinuities in the waterproofing membrane.

   b. Testing agency shall perform tests on abutting or overlapping smaller areas as necessary to cover entire test area.

   c. Testing agency shall create a conductive electronic field over the area of waterproofing to be tested and electronically determine locations of discontinuities or leaks, if any, in the waterproofing.

   d. Testing agency shall provide survey report indicating locations of discontinuities, if any.
B. Manufacturer's Field Service: Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components and to furnish daily reports to Architect.

C. If test results or inspections show waterproofing does not comply with requirements, remove and replace or repair the waterproofing as recommended in writing by manufacturer, and make further repairs after retesting and inspecting until waterproofing installation passes.

D. Prepare test and inspection reports.

3.11 PROTECTION

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect installed protection course, board insulation and drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

D. Protect the waterproof expansion joint system and its components during construction. Subsequent damage to the expansion joint system will be repaired at the general contractor's expense. After work is complete, clean exposed surfaces with a suitable cleaner that will not harm or attack the finish.

E. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

F. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 07 14 16
SECTION 07 17 00 - BENTONITE WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Bentonite waterproofing
   2. Molded sheet drainage panels

B. Related Requirements:
   1. Section 03 10 00 “Cast-in-Place Concrete” for forms, waterstops, and concrete.
   2. Division 07 Waterproofing and Air Barrier for flexible flashing that may be part of adjoining waterproofing and air barrier work.
   3. Section 07 20 00 “Thermal Insulation” for foundation insulation.
   4. Section 31 20 00 “Earth Moving” for excavating and backfilling.
   5. Section 31 50 00 “Excavation Support and Protection” for permanent below-grade support systems that require blind-side waterproofing.
   6. Section 33 46 00 “Subdrainage” for drainage pipe and conduits, drainage panels, and filter fabrics.

1.3 REFERENCES

A. References, General: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section.

B. ASTM International (ASTM): www.astm.org;
   2. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
   4. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
   5. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity
   6. ASTM D4716 - Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
10. ASTM E154 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

C. UL Environment Greenguard Certification: www.greenguard.org

1. Greenguard Certification Product Guide

D. U.S. Environmental Protection Agency (EPA): www.epa.gov

1.4 SUBMITTALS

A. Manufacturer: Submit product data sheets, specifications, installation instructions and general recommendations for each type of product specified.

B. Installer: Submit detail drawings for installation of product specified.

C. Water Sample Test Result: A water sample (2 liters) is required on projects that have ground water and should be submitted to the waterproofing manufacturer to test for contamination and compatibility with waterproofing membrane. Submit to architect a letter of compatibility recommending which formulation to use.

D. Warranty: Submit specimen of manufacturers’ standard warranty.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide Geotextile/Bentonite Clay waterproofing membrane produced by a manufacturer with a minimum of 5 years experience in the waterproofing industry.

B. Installer Qualifications: A firm with a minimum of 2 years experience in installing bentonite clay or other related waterproofing products.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original manufacturer’s packaging and store materials in strict accordance with manufacturer’s instructions.

B. Remove and replace products that have been prematurely exposed to moisture.

1.7 FIELD CONDITIONS

A. Install materials in accordance with all safety and weather conditions required by the manufacturer.

B. Install materials only after work on the applicable substrate is complete.
C. Complete cast-in-place reinforced columns prior to membrane installation.

1.8 WARRANTY

A. Upon completion and acceptance of the work required by this section, the manufacturer will issue a warranty agreeing to promptly replace defective materials for a period of 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carlisle Coatings & Waterproofing Incorporated, 900 Hensley Lane, Wylie, Texas 75098; (800) 527-7092; Fax: (972) 442-0076.


3. Tremco, Inc., Commercial Sealants and Waterproofing Division, Beachwood, OH; (866) 321-6357; email: techresources@tremcoinc.com; www.tremcosealants.com; or comparable product by one of the following:

B. Source Limitations: Provide waterproofing system materials and accessory products from a single-source system manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Waterproofing system shall be capable of performing as a continuous watertight installation and as a moisture drainage plane transitioned to adjacent flashings and discharging water to the building exterior. Waterproofing shall accommodate normal substrate movement, construction material transitions, opening transitions, penetrations, and perimeter conditions without resultant moisture deterioration.

B. Compatibility: Provide waterproofing system materials that are compatible with adjacent materials under conditions of service and substrates on which product is applied, as recommended by waterproofing manufacturer based on testing and field experience.

2.3 COMPOSITE BENTONITE WATERPROOFING SYSTEM

A. Geotextile or Geomembrane/Bentonite clay waterproofing membrane

1. CCW MiraClay; Carlisle Coatings & Waterproofing

2. Swelltite bentonite composite membrane waterproofing; Colloid Environmental Technologies Company (CETCO)

3. Composite HDPE/Bentonite Membrane: Composite membrane consisting of a 20-mil thick, HDPE geomembrane liner bonded to up to 1.0 lb/sq. ft. layer of bentonite clay granules, with a spun polypropylene facing.

   a. Product: Tremco, Inc. Paraseal LG.
2.4 ACCESSORY MATERIALS

A. Granular Bentonite: Sodium bentonite clay containing a minimum of 90 percent montmorillonite (hydrated aluminum silicate), with a minimum of 90 percent passing a No. 20 sieve.
   1. Carlisle Coatings & Waterproofing; CCW MiraCLAY Granules
   2. CETCO; Waterstoppage
   3. Tremco, Inc.; Paragranular

B. Bentonite Mastic: Trowelable consistency, bentonite compound, specifically formulated for application at joints and penetrations.
   1. CETCO; BENTOSEAL
   2. Tremco, Inc.; Paramastic

C. Termination Bar: Extruded aluminum or formed stainless steel bars with upper flange to receive sealant.

D. Plastic Protection Sheet: Polyethylene sheeting complying with ASTM D 4397; thickness recommended by waterproofing manufacturer to suit application but at least 6 mils thick.

E. Cement Grout Patching Material: Manufacturer’s recommended grout mix compatible with substrate being patched.

F. Masonry Fasteners: Case-hardened nails or hardened steel, powder actuated fasteners. Depending on manufacturer’s written requirements, provide ½ or 1 inch diameter washers under fastener heads.

G. Tapes: Waterproofing manufacturer’s recommended tape for joints between sheets, membranes, or panels. Use with recommended adhesive bonding primer.
   1. Reinforced Overlap Seam Tape: Reinforced, rubberized-asphaltic waterproofing seam tape
      a. CETCO; SeamTape
      b. Tremco, Inc.; Permanent Seam Tape
   2. Non-Reinforced Overlap Tape: Non-reinforced, adhesive tape of partially cross-linked polymeric elastomers 2-inch by 1/8-inch for molding form-fit seals around contours and for taping seams within overlaps.

   1. Carlisle Coatings & Waterproofing; CCW MiraSTOP
   2. Colloid Environmental Technologies Company (CETCO); WATERSTOP-RX
   3. Tremco, Inc.; Superstop

I. Joint Sealants: Termination Seals:
   1. Single component, high performance, medium-modulus, low-VOC, UV-stable, non-sag polyurethane sealant.
      a. Carlisle Coatings & Waterproofing; CCW MiraCLAY Sealant
      b. CETCO; CETSEAL
      c. Tremco, Inc.; Dymonic 100
2.5 WATERPROOFING PROTECTION AND DRAINAGE

A. Manufactured composite subsurface drainage panels
   1. Carlisle Coatings & Waterproofing; CCW MiraDRAIN
   2. CETCO; Aquadrain
   3. Tremco; TREMDrain

PART 3 - EXECUTION

3.1 EXAMINATION

A. Comply with contract documents and manufacturer’s product data, including product application and installation instructions.

B. Examine substrate and condition under which waterproofing will be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INTERFACE WITH OTHER WORK

A. Sequencing of Work: Coordinate sequencing of waterproofing installation with work of other sections that form portions of building envelope moisture control to ensure that flashings and transition materials can be properly installed and inspected.

B. Subsequent Work: Coordinate waterproofing installation with work of other sections installed subsequent to waterproofing to ensure complete inspection of installed waterproofing and sealing of waterproofing penetrations necessitated by subsequent work.

3.3 PREPARATION

A. Clean, prepare, and treat substrates. Fill voids with cement grout as recommended by manufacturer.

B. Protect adjacent work areas and finish surfaces from damage or contamination from waterproofing products during installation operations.

C. Grade substrates: Shall be level and uniform that is compacted to a minimum of 85% modified proctor.

D. Formed Concrete Surfaces: Remove fins and projections. Fill voids, form-tie holes, and other defects greater than ¼-inch in depth.

E. Horizontal Concrete Surfaces: Remove standing water, debris, and substances that may impair bonding of patching materials or effectiveness of waterproofing. Fill voids and other defects greater than ¼-inch in depth.

F. Excavation Support and Protection System: Fill minor gaps and spaces 1 wide or wider with appropriate filling material. Cover or fill large voids and crevices.

3.4 INSTALLATION, GENERAL

BENTONITE WATERPROOFING
A. Install waterproofing and accessories according to manufacturer’s written instructions. Protect bentonite material from wetting prior to permanent placement.

1. Install a continuous layer of waterproofing membrane with ends and edges lapped a minimum of 4 inches (102 mm). Stagger end joints, seal laps and treat fastener penetrations in accordance with manufacturer’s written instructions.
2. Apply granular bentonite around penetrations in horizontal surfaces and changes in plane according to manufacturer’s details.
3. Apply bentonite mastic at changes of plane, construction joints in substrate, projections, and penetrations.

B. REMOVE CLEAR SILICONIZED RELEASE LINER FROM BACK OF MEMBRANE PRIOR TO INSTALLATION. After removing the clear release liner, install waterproofing membrane with the bentonite compound side directly against the substrate surface to be waterproofed (white geomembrane side up facing installer) for both horizontal and vertical applications.

C. Protect waterproofing from damage and wetting during construction. Repair punctures, tears, and cuts.

D. Prevent geotextile/bentonite clay waterproofing membrane from hydrating before being covered with overburden. When threat of rain is imminent or backfill is not immediate, geotextile/bentonite clay waterproofing membrane should be covered with polyethylene sheeting.

3.5 VERTICAL BLINDSIDE WALL WATERPROOFING

A. Prior to membrane, install a continuous ¾-inch cant of mastic at footing / wall joint.

B. Inside Corners: Install a ¾-inch thick continuous cant of mastic at all vertical inside wall corners prior to installing membrane.

C. Penetrations: For all pipe, rebar, structural and other penetrations install waterproofing system in accordance with manufacturer’s detail for specific project condition(s).

D. Install membrane with the bentonite side to be in direct contact with shoring per contractor and over a continuous layer of drainage board. Drainage board is applied 4 feet above submerged conditions.

E. On shoring walls to receive shotcrete, install membrane with a minimum 6 inches sheet edge overlaps. Tack membrane to highest point of shoring. All overlaps of membrane must be treated in accordance with manufacturer’s details.

F. Excavation Support and Protection: Cut, clean, and treat tiebacks and similar projections. Encase tieback rods, nuts, and plates. If water is present, cover shoring and lagging with plastic protection sheets. If water is present, set up a dewatering system to remove water.

3.6 WALL APPLICATION

A. Install bentonite membrane with the white non-woven side out, facing the installer.

B. Starting at the bottom of the wall, unroll bentonite membrane and nail across top of panel one nail per 12-inch on center. Allow sheet to hang down nailing only as required to stabilize.
C. Install adjacent membrane by overlapping edges a minimum of 4-inch.

D. Fasten membrane once every 18-inches on seams or as required to prevent blousing with \( \frac{3}{4} \)-inch to 1-inch concrete nails with washers.

E. Extend waterproofing membrane to 6-inches below grade and fasten membrane to the substrate to maintain constant compression using a 1/8-inch by 1-inch minimum termination bar. Trowel a \( \frac{3}{16} \)-inch thick and 2-inch wide bead of sealant at top edge of membrane and cover termination bar.

F. Create a cant at any vertical to horizontal transition by applying a 1 \( \frac{1}{2} \)-inch to 2-inch cant of bentonite granules or sealant.

G. Strip in all outside corners and transitions with a min. 12-inch piece of bentonite membrane to double cover these areas.

H. Make a min. 1-inch cant at all inside corners with sealant.

I. Backfill must be compatible, soils free of construction debris and must be uniformly compacted to a minimum 85\% Modified Proctor density on each lift.

3.7 HORIZONTAL WATERPROOFING

A. Horizontal Roofs, Plazas, and between Slabs: Install waterproofing membrane starting at lowest point, with ends and edges overlapped a minimum of 4 inches and tape sealed.

1. Prime concrete substrates. Primer may be omitted on concrete surfaces that comply with requirements for dryness, surface texture, and freedom from imperfections.
2. Install bentonite side of membrane against the material to be waterproofed.
3. Terminations at Vertical Surfaces: Provide a fillet or cant at intersection of horizontal and vertical substrates. Cover waterproofing with a plastic slip-sheet.

3.8 BELOW-SLAB WATERPROOFING

A. Below Structural Slabs-on-Grade: Apply waterproofing membrane with HDPE side down.

1. Install membrane sheets bentonite-side up. Staple seams where subject to displacement during concrete placement.
2. Install under footings, grade beams, and pile caps; or continue waterproofing through key joints between footings and foundation walls, and extend a minimum of 8 inches up or beyond perimeter slab forms. Stagger seams minimum 12 inches.
3. Install under slabs starting at lowest point, install a continuous layer of waterproofing membrane, with ends and edges lapped a minimum of 4 inches.
4. Protect waterproofing from damage caused by reinforcing bar supports with sharp edges.

3.9 DRAINAGE PANEL INSTALLATION

A. Place and secure drainage panels in accordance with manufacturer’s written instructions. Use adhesives that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, waterproofing application, protection, and drainage components, and to furnish reports to Architect.

B. Reporting: Forward written inspection reports to the Architect of the inspection and test being performed.

C. Correction: Correct deficient applications not passing tests and inspections, make necessary repairs, and retest as required to demonstrate compliance with requirements.

3.11 PROTECTION AND DRAINAGE

A. Protect membrane from moisture prior to concrete placement.

B. Protect the waterproofing membrane with drainage composite.

C. Install the drainage composite according to the detailed drawings for the specific installation requirements of the project.

3.12 BACKFILL

A. Backfill with smooth and uniform material with no sharp projections or stones larger than 3/4”. Compact backfill to an 85% Modified Proctor density. Ensure backfill material is not contaminated with salt or other materials that could prevent the waterproofing membrane from hydrating. Care should be used during backfill operation to avoid damage to the waterproofing system. If damage occurs, cease backfilling and report damage. Damaged waterproofing must be repaired per manufacturer’s guidelines.

3.13 CLEAN UP

A. Clean areas where adjacent finished surfaces are soiled by work of this Section, consult manufacturer of surfaces for cleaning advice and conform to their recommendations and instructions. Remove all tools, equipment and remaining product on-site. Dispose of section work debris and damaged product following all applicable regulations.

END OF SECTION 07 17 00
SECTION 07 19 00 - WATER REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes **penetrating** water-repellent treatments for the following vertical and horizontal surfaces:
   1. Cast stone.
   2. Clay brick masonry.
   3. Natural stone.

B. Related Requirements:
   1. Section 042000 "Unit Masonry" for integral water-repellent admixture for unit masonry assemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include manufacturer's printed statement of VOC content.
   2. Include manufacturer's standard colors.
   3. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.
   4. Include printout of current "MPI Approved Products List" for each product category specified in Part 2 that specifies water repellents approved by MPI, with the proposed product highlighted.

B. Samples: For each type of water repellent and substrate indicated, 12 by 12 inches (300 by 300 mm) in size, with specified water-repellent treatment applied to half of each Sample.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Applicator testing agency.

B. Product Certificates: For each type of water repellent.

C. Preconstruction Test Reports: For water-repellent-treated substrates.
D. Field quality-control reports.
E. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.
B. MPI Standards: Comply with MPI standards indicated and provide water repellents listed in its "MPI Approved Products List."
C. Mockups: Prepare mockups of each required water repellent on each type of substrate required to demonstrate aesthetic effects, for preconstruction testing, and to set quality standards for materials and execution.
   1. Locate mockups on existing surfaces where directed by Architect in locations that enable viewing under same conditions as the completed Work.
      a. Size: 10 sq. ft. (9.3 sq. m) each.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing: Engage a qualified testing agency to perform preconstruction testing of water repellents on field mockups on existing substrate assemblies.
   1. In addition to verifying performance requirements, use mockups to verify manufacturer’s written instructions for application procedure and optimum rates of product application to substrates.
   2. Propose changes to materials and methods to suit Project.
   3. Notify Architect seven days in advance of the dates and times when mockups will be tested.

1.8 FIELD CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
   1. Concrete surfaces and mortar have cured for not less than 28 days.
   2. Building has been closed in for not less than 30 days before treating wall assemblies.
   3. Ambient temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C) and will remain so for 24 hours.
   4. Substrate is not frozen and substrate-surface temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C).
   5. Rain or snow is not predicted within 24 hours.
   6. Not less than 24 hours have passed since surfaces were last wet.
7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.
8. 

1.9 WARRANTY

A. Special Warranty: Manufacturer’s standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Performance: Water repellents shall meet the following performance requirements as determined by preconstruction testing on substrates representing those indicated for this Project.

B. Water Absorption: Minimum 85 percent reduction of water absorption after 24 hours for treated compared to untreated specimens when tested according to the following:
   3. Natural Stone: ASTM C 97/C 97M.

C. Water-Vapor Transmission: Comply with one or both of the following:
   1. Minimum 80 percent water-vapor transmission of treated compared to untreated specimens, according to ASTM D 1653.

D. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate of treated compared to untreated specimens, according to ASTM E 514/E 514M.

E. Durability: Maximum 5 percent loss of water-repellent performance after 2500 hours of weathering according to ASTM G 154 compared to water-repellent-treated specimens before weathering.

F. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.
   1. Reduction of Water Absorption: 80 percent.
   2. Reduction in Chloride Content: 80 percent.

2.2 PENETRATING WATER REPELLENTS

A. Silane/Siloxane-Blend, Penetrating Water Repellent: Clear, silane and siloxane blend with 400 g/L or less of VOCs.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.

1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
3. Verify that required repairs are complete, cured, and dry before applying water repellent.

B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, according to repellent manufacturer's written instructions.

B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions and as follows:

1. Precast Concrete: Remove oil, curing compounds, laitance, and other substances that inhibit penetration or performance of water repellents according to ASTM E 1857.
3. Natural Stone: Section 040310 "Historic Masonry Cleaning."

C. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.

D. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.

E. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply coating of water repellent on surfaces to be treated using 15 psi- (103 kPa-) pressure spray with a fan-type spray nozzle to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

1. Precast Concrete: At Contractor's option, first application of water repellent may be completed before installing units. Mask mortar and sealant bond surfaces to prevent water repellent from migrating onto joint surfaces. Remove masking after repellent has cured.

C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.4 FIELD QUALITY CONTROL

A. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:

1. Owner will engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.

2. Testing agency will perform tests for compliance of water-repellent material with product requirements.

3. Owner may direct Contractor to stop applying water repellents if test results show material being used does not comply with product requirements. Contractor shall remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Architect.

B. Coverage Test: In the presence of Architect, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.

1. Notify Architect seven days in advance of the dates and times when surfaces will be tested.

2. Reapply water repellent until coverage test indicates complete coverage.
3.5 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.

B. Comply with manufacturer's written cleaning instructions.

3.6 SCHEDULE

A. Apply Water Repellent to all stone surfaces of existing construction after restoration and cleaning.

B. Do not apply water repellent to brick surfaces unless specifically directed by Owner and Architect as part of Construction Change / Change Order.

END OF SECTION 07 19 00
SECTION 07 21 16 – BATT AND BLANKET INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

B. Building Insulation for Acoustical Applications.

C. Fire Safing Insulation

D. Misc. Cavity Infill

1.3 RELATED REQUIREMENTS

1. Section 071416 "Cold Fluid-Applied Waterproofing" for insulated panels installed with plaza decks and at vertical waterproofing.

2. Section 072119 "Foamed-in-Place Insulation" for spray-applied polyurethane foam insulation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: Submit certification/letter from material supplier(s) indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content per TBR Sustainability Guidelines.

   a. Include statement indicating cost for each product having recycled content.

2. Laboratory Test Reports and certifications: For insulation, indicating compliance with requirements for low-emitting materials.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 ACOUSTICAL INSULATION

A. Insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 40 percent.

C. Mineral-Wool Blanket, Unfaced Sound Batts. ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Greenguard Certified. Density minimum per ASTM C 612-00 of 2.87lbs/ft3 (45 kg/m3)

1. Basis-of-Design Product: Subject to compliance with requirements, provide Roxul Inc; AFB or comparable product by one of the following:
   a. Owens Corning
   b. Johns Manville

2. Thickness: 3 inches

2.2 SAFING INSULATION

A. Insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 35 percent.

C. Unfaced Mineral Fiber Safing Insulation: ASTM C 612 Type 1-4, ASTM E814 Through Penetration Firestops (used to rate approved assemblies); ASTM E136 noncombustible, ASTM C1338 Fungi Resistant, ASTM E 84 maximum flame-spread 5 or less and smoke-developed index of 0, ASTM 665 (corrosiveness to steel) passes, Approved in referenced UL assemblies.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Roxul Inc; AFB or comparable product by one of the following:
   a. Owens Corning
b. Johns Manville

2. Thickness: 2-4 inches, layered as required to fill joint/cavity.

2.3 MISC. CAVITY INFILL INSULATION (UNRATED ASSEMBLIES)

A. Insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 35 percent.

C. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

1. Thickness: as required to fill cavity

2.4 INSULATION FASTENERS

1. Mechanical Fasteners as recommended by insulation manufacturer for application intended and approved by code agencies for application.

2.5 ACCESSORIES

A. Adhesive for Bonding Insulation: Product compatible with insulation and adjacent materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

1. Adhesives shall have a VOC content of 70 g/L or less.
2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.
B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF BATT/BLANKET INSULATION IN FRAMED CONSTRUCTION

A. Batt/Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.

2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically.

5. Install to match referenced acoustical or rated assembly. Coordinate with components referenced in other sections of the project manual.

B. Combustible Cavities: Install insulation in all combustible cavity spaces indicated on drawings plus all nonaccessible spaces above suspended hard ceilings (such as plaster or gypsum board not attached directly to underside of framing or with furring greater than 祯 inch) and/or where sprinkler systems would be required if cavity is not filled with insulation. Do not install above acoustical tile ceilings unless noted otherwise:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.4 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 16
SECTION 07 21 19 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section Includes:
      1. Open-cell spray polyurethane foam.
   B. Related Requirements:
      1. Section 079200 “Joint Sealants” for spray polyurethane foam insulation installed as part of a barrier system.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For Installer.
   B. Product Test Reports: For each product, for tests performed by a qualified testing agency, IAS International Accreditation Service.
   C. Evaluation Reports: For spray-applied polyurethane foam-plastic insulation and thermal barrier system, from ICC-ES.

1.5 QUALITY ASSURANCE
   A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer. Any repairs by an Icynene licensed contractor.
   B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   C. Fire Resistance Characteristics: As determined by testing identical products (based on a 4 inch (100 mm) minimum thickness) according to ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
D. **Fire Resistance Characteristics**: As determined by testing identical products according to NFPA 285 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. Protect spray polyurethane foam components as follows:

1. Component A and B: store between 60 degrees F (15 degrees C) and 90 degrees F (32 degrees C).
2. Component B can be frozen but must be protected from overheating over 120 degree F (49 degree C) and prolonged storage over 100 degree F (37 degree C).
3. Component B: mix thoroughly prior to use.
4. Components should be a matched set (system) as supplied by the manufacturer.
5. Use components within their labeled shelf-life.
6. Use components as supplied with no site alterations or additions.

1.7 **WARRANTY**

A. Refer to manufacturer’s standard warranty terms (as applicable).

**PART 2 - PRODUCTS**

2.1 **PERFORMANCE CHARACTERISTICS**

A. **Air Material Air Leakage Rate**: Maximum material air leakage rate of less than 0.004 cfm/ft² under a pressure differential of 0.3 in w.g. (1.6 psf) (0.02 L/m² at 75 Pa) per ASTM E 2178 or E 282.

B. **Surface-Burning Characteristics**: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Development Index: 450 or less.

C. **Fire Propagation Characteristics**: Passes NFPA 285 testing as part of an approved assembly.

D. **Compressive strength**: Minimum 40 psi (276 kPa) (ASTM C1029 Type II).

E. **Sustainability Requirements**: Provide spray polyurethane foam insulation as follows:

1. Low Emitting: Insulation tested according to CA/DPH/EHLB/v1.1-2010.
2. Resistant to fungal growth as per ASTM C1338.
3. Containing no PBDE.
2.2 OPEN-CELL SPRAY POLYURETHANE FOAM

A. Open-Cell Spray Polyurethane Foam: Spray-applied polyurethane foam using water as a blowing agent. Minimum density of 0.5 lb/cu. ft. (8.0 kg/cu. m) and minimum aged R-value at 1-inch (25.4-mm) thickness of 3.7 deg F x h x sq. ft./Btu at 75 deg F (0.65 K x sq. m/W at 24 deg C).

1. Basis-of-Design Product: Subject to compliance with requirements, provide Icynene Inc.; Icynene Classic Eco or comparable product by one of the following:
   a. BASF Corporation.
   b. Bayer Material Science (Bay Systems)

2.3 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

B. Thermal Barrier: Provide thermal barrier or ICC-approved alternative assembly using intumescent coatings.
   1. Thermal Barrier: Foil Thermal Barrier Blanket approved for use by manufacturer for insulation product. Basis of Design: Icynene Fi-Foil Perforated, or
   2. ICC-Approved Intumescent Coating: Basis of Design: Icynene DC315, 22 mil thickness

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.

B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Spray insulation to envelop entire area to be insulated and fill voids.

C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

D. Do not apply insulation within 3-inches (76 mm) of heat emitting devices or where the temperature is in excess of 200 degrees F (93 degrees C), as per ASTM C411 or in accordance with applicable codes.

E. Framed Construction: Install into cavities formed by framing members to achieve the following thicknesses:
   1. Roof areas with drop ceilings below: 5.5 inches
2. Roof areas with gypsum board on furring applied directly to rafters (at mansard areas) – thickness to fill rafter cavity.

F. Miscellaneous Voids: Apply according to manufacturer's written instructions.

3.3 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Thermal Protection: Protect installed spray polyurethane foam insulation with qualified thermal or ignition barrier per applicable building codes.

3.4 INSTALLATION OF THERMAL BARRIER COMPONENTS

A. Install thermal barrier components – membranes and accessories – as required to meet NFPA and IBC code requirements.

B. Thermal barrier product to be applied at all roof/ceiling areas where the insulation is not in contact with gypsum board ceiling finish.

END OF SECTION 07 21 19
SECTION 07 31 00 - SLATE ROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Natural slate roofing shingles.
B. Moisture shedding underlayment.
C. Metal roof flashing.
D. Snow guards.
E. Roofing cant and nailing strips.
F. Roofing nails.
G. Hip and Ridge Cap.

1.2 RELATED SECTIONS

A. Section 06100 - Rough Carpentry: Framing and Sheathing.
B. Section 06150 - Wood Decking.
C. Section 07600 - Flashing and Sheet Metal.

1.3 REFERENCES

B. ASTM A 666 - Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet and Strip.
C. ASTM B 101 - Specification for Lead-Coated Copper Sheet and Strip for Building Construction.
D. ASTM B 370 - Specification for Copper Sheet and Strip for Building Construction.
I. ASTM D 312 - Specification for Asphalt Used in Roofing.


1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Details for specially configured metal flashing, jointing methods and locations for flashing, and other roofing system details.

D. Selection Samples:
   1. Pieces of actual slate shingles, illustrating complete range of colors available, for Architect's selection.
   2. Pieces of actual metal ridge cap, 12 inches (300 mm) long and full width.
   3. Actual snow guard, full size.

E. Verification Samples:
   1. Actual slate shingles in color selected, illustrating full range of color variation to be expected in finished work.
   2. Underlayment 12 inches (300 mm) square.

F. Material Test Reports: For each slate type, performed by a qualified testing laboratory as approved by North Country Slate, per ASTM C406.

G. Certificate of Country of Origin: For each type of slate, identifying the country in which the slate shingles were quarried and fabricated.

H. Distributor's Warranties: Distributors warranty for slate shingles specified.

I. Installer's Warranties: Installers warranty for work specified.

J. Installer's Qualifications: Installer's natural roofing slate project references; not fewer than four.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Company experienced in installing natural slate roofing of the type and scope specified in this section and employing persons with not fewer than five years of documented experience. Company shall provide skilled workers, thoroughly trained and experienced in the necessary crafts of natural slate roof systems and who are familiar with this specification and methods.
required for a warrantable roof.

B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups, unless such deviations are specifically approved by Architect in writing.
2. Install in area and of size designated by Architect.
3. Do not proceed with remaining work until finish color, texture, pattern, joint sizes, and installation workmanship are approved by Architect.
4. Correct mock-up area as required to produce acceptable work.
5. Mock-up may be incorporated into final construction upon Owners approval.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver shingles to project site in distributor's crates/pallets, labeled with data indicating source.
B. Handle shingles to prevent chipping, breakage, soiling, or other damage. Protect edges with wood or other rigid material.
C. Place and stack crates/pallets to distribute weight evenly and to prevent breakage or cracking.
D. Store underlayment rolls on end, on pallets or other raised surfaces. Do not double stack rolls.
E. Protect unused underlayment from weather, sunlight and moisture when left overnight or when roofing work is not in progress.
F. Stage roofing materials on the building in a manner to avoid significant or permanent damage to the roof deck or structural supporting members.

1.7 WARRANTY

A. Slate Shingle Distributors Warranty: Submit slate shingle distributors warranty, signed by the distributor and covering the slate shingles described in this section, in which the distributor agrees to replace slate shingles that fail in materials. The duration of this warranty shall be established by ASTM C406 and grade indicated in this specification.
B. Roofing Installer's Warranty: Submit roofing installer's warranty, signed by roofing Installer and covering Work of this Section, in which roofing Installer agrees to repair or replace slate roofing that fails in materials or workmanship within the following warranty period:
   1. Warranty Period: Five years from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Provide an additional 1 percent of installed field slates for Owners use in roof maintenance.

PART 2 PRODUCTS

2.1 MANUFACTURES

A. Use slate from owner's existing stock for replacement of roof tiles at areas indicated. If quantity of owner's existing stock is exceeded for re-roof area, provide new slate to match existing.
B. Manufacturers which provide slate include but are not limited to North Country Slate, 8800 Sheppard Ave. E., Toronto, ON, Canada M1B 5R4. ASD. Tel: (416) 724-4666. Toll Free Tel: (800) 975-2835.
2.2 SHINGLES

A. Slate Shingles: Hard, dense, sound rock, with chamfered edges, punched or drilled for two nails each. Slate shingles shall be punched or drilled back to front, and on the thinner end when there is variation in thickness along the length of the shingle.

B. No slate shingles with broken corners shall be installed when either the base or leg of the right triangle piece broken off is greater than 1-1/2 inches (38 mm). No broken corners on covered ends which sacrifice nailing strength or laying a watertight roof. Broken corners are acceptable for cutting stock. Not more than 2 percent of broken slates, including those having cracks materially precluding ringing when sounded, shall be accepted.

C. Slate shall be free of any visible inclusions of oxidizable iron pyrite.

D. Curvature or twist in slate shingles shall not exceed 1/8 inch in 12 inches (3 mm in 100 mm). Curved slate shingles shall be trimmed and punched to permit them to be laid with convex side up. Knots, knurls and cramps are acceptable on the exposed slate shingle face. Knots, knurls and cramps on the back or covered portion of slate shingles, which prevent close contact of slate shingles or the laying of a watertight roof, will not be accepted.

E. Slate shingles shall be trimmed with 90-degree square corners. Face dimensions of slate shingles shall not differ from those specified by more than 1/8 inch (3 mm).
   1. Source: Obtain slate required for the project from a single quarry, with consistent color range, physical properties and texture throughout.
   2. Grade: ASTM C 406 Grade S2: Expected service life 40-75 years.
   3. Thickness: To match existing.
   4. Size: To match existing.
   5. Unit of Measurement: The number of pieces per square for metric dimension slates, not exact dimensional equals to inch dimension slates, shall be adjusted upward for their smaller coverage per square.
   6. Starter Slate Size: Length of starter slates to be the exposure of the field slates plus the specified headlap and rounded up to the nearest full inch. Starter slates are to be front-side punched and installed chamfered edge down.

2.3 UNDERLAYMENT


2.4 SHEET METAL FLASHINGS

A. Flashing: ASTM B 370 copper, cold rolled, 16 oz/sq ft (0.56 mm thick), natural finish.

2.5 ACCESSORIES

A. Snow Guards: Fabricated from non-ferrous metal, designed to be installed without penetrating slate shingles, and complete with predrilled holes or hooks for anchoring. Match existing snow guards or reuse existing where possible.

B. Slating Nails for Non-Preservative, or Preservative Treated Plank or Plywood Deck and Nailers: Slater’s stainless steel ring shank nails, 0.120 inch (3 mm) or No. 11 gauge Stubs, not less than twice
the nominal slate thickness plus 1 inch (25.4 mm) in length, with 3/8 inch (9 mm) head. Point should penetrate through underside of deck except where the underside of roof deck is exposed to view, where shorter nails are acceptable. Nails 1/2 inch (13 mm) or longer than field slate nails for slate hip and ridge installation.

C. Wood Nailers and Cant Strips: Preservative-treated wood, as specified in Section 06100 - Rough Carpentry, attached with Type 304 or 316 stainless steel nails.

D. Felt Underlayment Nails: stainless-steel, wire nails with low-profile capped heads or disc caps, 1 inch (25 mm) minimum diameter.

E. Polymer Sealant: ASTM C 920 silicone sealant of type, grade, class, and use classification required to seal joints in slate-shingle roofing and remain watertight.

2.6 FLASHING FABRICATION

A. Form flashing to profiles indicated on drawings and as required to protect roofing materials from physical damage and shed water.

B. Form sections square and accurate in profile, in maximum possible lengths, free from distortion or defects detrimental to appearance or performance.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that roofing penetrations and plumbing stacks are in place and properly flashed to deck surface.

B. Verify that roof openings are correctly framed.

C. Verify that deck surfaces are sound, smooth, properly secured; and free of ridges, depressions and voids; properly sloped and dry.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with slate shingle distributor’s recommendations on preparation of acceptable roof deck.

B. Broom clean deck surfaces prior to installation of underlayment.

3.3 INSTALLATION

A. Proceed with installation only after written approval and acceptance of all materials and accessories has been issued by the architect.

B. Underlayment:
   1. Install a minimum of two layers of No. 26 asphalt-saturated felt or one layer of No. 40 asphalt-saturated and coated felt with standard-size slate, as long as the slate is laid with a 4 inch (100 mm) minimum head lap.
   2. Install underlayment over entire deck surface. At hips, valleys, and ridges, install additional 36 inch (915 mm) width of underlayment, centered on the valley or ridge.
   3. On overhanging eaves that require more than a single 36-inch (915 mm) width of underlayment, overlap not less than 6 inches (150 mm), assuring that overlapped area is located on overhang, outside wall line.
1. Install flashing at all locations where roof intersects other roofs, sidewall or parapet walls, chimneys, ventilators, and similar projections, and at gable edges. Ensure that dissimilar sheet and fastener metals are galvanically separated.
2. Open Valley: Install minimum 20 inch (510 mm) wide open valley sheet metal flashing over 36 inch (915 mm) wide underlayment, with field underlayment lapped over edges of flashing not less than 4 inches (100 mm). Fasten metal with cleats. Overlap metal a minimum of 8 inches (200 mm).

D. Wood Nailer and Cant Strips:
1. Cant Strip: Install 2 inch (50 mm) wide by 48 inch (1220 mm) long wood cant strips at eaves. Nominal thickness of cant strip shall be equal to the slate thickness specified. Attach with hot-dip galvanized steel nails. Apply eave flashing and underlayment over cant strip.
2. Nailers: Install 2 inch (50 mm) wide by 48 inch (1220 mm) long preservative treated wood nailers as detailed at ridge and hips, directly over underlayment. Nominal thickness of ridge nailer shall be equal to two times the slate thickness specified. Nominal thickness of hip nailers shall be three times the slate thickness specified. Attach with Type 304 or 316 stainless steel nails. Protect with additional layer of underlayment before installing hip and ridge accessory.

E. Slate Grading:
1. Slate Grading: Sort slates according to thickness into a minimum of three grades. Install thickest slates beginning at the eaves and introduce consecutive thickness grades as installation proceeds up the roof slope, creating a smooth overall appearance. Blend slates from all crates/pallets together to achieve a uniform color and texture to the roof.

1. Match existing shingle pattern. Where existing shingle pattern conflicts with information in next paragraphs, match existing shingle pattern.
2. Double shingles at eaves and cornice line. Beginning at eaves, project shingle 2 inches (50 mm) beyond perimeter with no gutters or troughs, or 1 inch (25 mm) with gutters or troughs. Lay shingles in horizontal courses. Provide at least the specified head lap between succeeding courses of shingles and stagger joints between courses a minimum of 3 inches (75 mm). Provide 1 inch (25 mm) to 2 inches (50 mm) projection of shingles at gable and rake edges.
3. Cut and fit shingles neatly around vents, pipes, ventilators, and other roof projections.
4. Slate shingles overlapping sheet metal shall have nails placed so as to avoid penetrating the sheet metal.
5. Nail slate shingles so nail heads touch shingle lightly, without producing strain on the slate.

G. Hips:
1. Install slate shingles at hips in pattern as indicated on drawings and nail in place. Only where heads of nails are exposed, cover with plastic cement. Match appearance of existing adjacent construction.

H. Ridges:
1. Install slate shingles at ridges in pattern as indicated on drawings and nail in place. Only where nail heads are exposed, cover with plastic cement. Match appearance of existing adjacent construction.

I. Snow Guard Installation: Install snow guards in rows at locations indicated according to manufacturers
written installation instructions. Space snow guards in each row, offsetting by half this dimension between succeeding rows. Match existing construction.

J. Adjusting and Clean Up:
   1. Remove and replace damaged or broken slates using slate repair hooks or nail and bib repair procedure where standard nailing is not possible.
   2. Remove excess materials and debris from the Project site.

3.4 PROTECTION

   A. Lay out progression of work to prevent other trades from working on or above completed roofing.

   B. Minimize traffic over finished roof surface. If necessary, wear soft-soled shoes and walk on the 'butt' of the shingles in order to avoid breakage.

END OF SECTION 07 31 00
SECTION 07 50 35
TOTAL ROOFING SYSTEM WARRANTY INSTRUCTIONS

PART 1 – GENERAL: not used

PART 2 – PRODUCTS

2.01 The Total Roofing System Warranty shall be provided on the form of Section 07 50 36. No other warranty form is acceptable, and no other warranty, stipulations, or qualifications may be incorporated or attached. If more than one building, roof, or type of membrane is provided in the Contract, provide a separate warranty for each, even if they are alike. All informational blanks on the warranty form shall be filled in prior to execution.

PART 3 – EXECUTION

3.01 Prior to the Manufacturer’s final inspection, which is a distinct and different inspection from the Designer’s final inspection of the Work of the Contract, and prior to the Manufacturer’s execution of the Total Roofing System Warranty, submit a mock-up of the Total Roofing System Warranty to the Designer, completely filled out with all information except, if not yet certain, the warranty number and individual persons names, titles, signatures, dates of signature, and contact information. Obtain Designer’s approval of this mock-up, and use this for the executed warranty. Execute the Warranty in two (2) counterparts for inclusion in the two (2) sets of Project data Binders (See specification section 01 78 21). All signatures on counterparts shall be “wet” (blue ink on paper, affixed by hand) signatures. Provide copies attached to final pay requests (See specification 01 29 76).

3.02 Filling in the upper portion of page 1:

A. SBC Project Number: fill in the “the Project” identification shown on page 1 of the construction Agreement in the format of 000/000-00-000XX, in which characters might or might not have been included for the Xs.

B. Warranty Period: fill in “thirty (30) years”.

C. Warranty Number: fill in a unique number provided by the Manufacturer for its own tracking purposes. Fill this in identically in the blanks near the upper right of each page of the form.

D. Building, Campus and Address: fill in:
   1. the name of the institution;
   2. “main campus” or the name of the campus if not the main campus;
   3. the name of the building and address or the campus ID number;
   4. if only a portion of a building, indicate which portion using conventions of the institution;

E. Roofing System Manufacturer & Address: fill in completely.

F. Roofing System Manufacturer Contact, Phone, and Email: fill in the name of the appropriate person to provide warranty service response on behalf of the Manufacturer, and their commonly used phone number and email address.

G. Manufacturer Authorized Roofing Applicator: fill in name and address of the “Roofing Contractor” (or subcontractor) that installed the System covered by this warranty.

H. Designer: fill in name of Designer shown on page 1 of the construction Agreement.

I. Contractor: fill in name of the general Contractor shown on page 1 of the construction Agreement, if different from the Applicator identified above. If the same, fill in “same”.

3.03 Filling in THE TOTAL ROOFING SYSTEM COMPONENTS on page 1

Refer to the roofing system specifications for the list of components to be included in the Total Roofing System Warranty. The components already named in the form shall be included if they occur in this system. Strike out components already named in the form that are not included in this roofing system and add components not already named in the form that are specified for inclusion.
3.04 Filling in where THE ROOFING CONTRACTOR CERTIFIES on page 1:
   A. Roofing Contractor: fill in the name of the Roofing Contractor, same as the Authorized Roofing Applicator above (per 3.02.G in this section).
   B. Authorized Signature: a suitably authorized representative of the Roofing Contractor with authority to bind the Roofing Contractor to the terms of this certification shall sign here.
   C. Fill in the name of the person providing the Authorized Signature, their title within the Roofing Contractor organization, and the date on which the signature is affixed.

3.05 Filling in where THE MANUFACTURER WARRANTS on page 1:
   A. Manufacturer: fill in the name of the Manufacturer, same as the Roofing System Manufacturer above (per 3.02.E in this section).
   B. Authorized Signature: a suitably authorized representative of the Manufacturer with authority to bind the Manufacturer to the terms of this Warranty shall sign here.
   C. Fill in the name of the person providing the Authorized Signature, their title within the Manufacturer organization, and the date on which the signature is affixed.

3.06 Filling in the ROOFING SYSTEM INFORMATION on page 2:
   A. Fill in an “X” or similarly in one of the provided boxes to indicate that the roof is a “New Roof” over new construction or is a “Reroof” over existing construction.
   B. Warranty Number: fill in same as in upper right of page 1.
   C. Area of Roof Installed: fill in the total square feet (SF) of the roof installed.
   D. Date of Substantial Completion: Fill in the date certified by the Designer.
   E. Date of Warranty Expiration: Fill in the date equal to the Date of Substantial Completion (per 3.06.D this section) plus the Warranty Period filled in at the top of page 1 (per 3.02.B this section).
   F. ROOFING SYSTEM COMPONENTS:
      Complete all information for each item listed. Provide complete description of each component in the system. When different components or systems are present, describe each condition and location. If the particular component is not used in this system, fill in “n/a” in the space.
   G. MANUFACTURER’S MEMBRANE INFORMATION:
      Provide Manufacturer unique roll identification number for each roll used in this project.
   H. MANUFACTURER FINAL INSPECTION:
      1. The Manufacturer’s final inspection is limited in scope to the Roofing System, and is a distinct and different inspection from the Designer’s final inspection of the Work of the Contract.
      2. Fill in name and title of the Manufacturer’s representative making the inspection. Fill in the date of the inspection. Provide signature by that representative.
      3. Fill in the name and title of the Designer representative that was present at inspection.
      4. Fill in the name and title of the Owner’s representative (other than the Designer) that was present at inspection.

3.07 Executing the Warranty by the TOTAL ROOFING SYSTEM MANUFACTURER at the bottom of page 4:
   A. Fill in Roofing System Manufacturer’s name, same as on page 1 (per 3.02.E and 3.05.A this section).
   B. Once the roof work is acceptable to the Roofing System Manufacturer, affix signature of Roofing System Manufacturer’s authorized and binding representative. Fill in date of signature.
   C. Fill in the name and title of the Roof System Manufacturer’s signatory.

END OF SECTION
SECTION 07 50 36
TOTAL ROOFING SYSTEM WARRANTY
State of Tennessee

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<tr>
<th>SBC Project Number</th>
<th>Warranty Period (Years)</th>
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<th>Roofing System Manufacturer (&quot;Manufacturer&quot;) and address</th>
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The Roofing System Manufacturer, (Manufacturer) warrants to the Tennessee Board of Regents (Owner) of the above building, that subject to the Terms, Conditions, and Limitations stated in this no dollar limit (NDL) warranty, the Manufacturer will repair any leak in the Total Roofing System installed by a Manufacturer authorized roofing applicator (Roofing Contractor) for a period stated above commencing with the date of Substantial Completion. The Manufacturer will repair or replace system defects or failures.

THE TOTAL ROOFING SYSTEM COMPONENTS are defined as the following; all materials as manufactured or authorized by the Manufacturer: including, but not limited to: membrane, flashings, counterflashings, adhesives and sealants, insulation, cover boards, fasteners, fastener plates, fastening bars, metal work, insulation adhesives, and any other products utilized in this installation. (Strike out materials not included in this system and add other materials included as required):

THE ROOFING CONTRACTOR CERTIFIES that the Total Roofing System was installed in strict accordance with the Manufacturer’s recommendations utilizing only the Manufacturer’s authorized products to install the Total Roofing System and that all products were protected while in their possession prior to installation and had no moisture or water trapped in the Total Roofing System. The Roofing Contractor certifies that all necessary steps were taken to ensure that all conditions were met for the issuance of The Total Roofing System Warranty by the Manufacturer.

Roofing Contractor
Authorized Signature
Print or Type Name          Title          Date
_________________________________________  ________________________________  __________

THE MANUFACTURER WARRANTS that if it cannot supply a specified product for inclusion in a Total Roofing System Warranty, the Roofing Contractor must obtain prior written approval from the Manufacturer for all products not supplied by the Manufacturer to be incorporated in the Total Roofing System Warranty. The Manufacturer will issue a Total Roofing System Warranty. In addition to a final inspection of the completed installation by the Manufacturer, the Manufacturer is also entitled to supplement their final field inspection with the Roofing Contractors above certification. There will be NO exceptions or exclusions to the Total Roofing System Warranty based upon products used or installation issues by the authorized Roofing Contractor, provided all materials installed are provided or authorized by the Roofing System Manufacturer.

Manufacturer
Authorized Signature
Print or Type Name          Title          Date
_________________________________________  ________________________________  __________

Total Roofing System Warranty
07 50 36 - 1
ROOFING SYSTEM INFORMATION

☐ New Roof  ☐ Reroof

Warranty Number

Area of Roof Installed (SF)       Date of Substantial Completion       Date of Warranty Expiration

TOTAL ROOFING SYSTEM COMPONENTS  – list all that apply:

Type of Roof deck(s)

Type of metal flashing / trim / coping, etc.

Type of vapor barrier

Type of air barrier

Type and thickness of flat insulation       Method of attachment

Type and slope of tapered insulation       Method of attachment

Type of recovery board       Method of attachment

Type of flashing       Method of attachment

Membrane type and color

MANUFACTURER’S MEMBRANE INFORMATION
List manufacturer’s roll identification for ALL rolls of used: If additional space is needed, attach additional sheet

Print or type name and title

MANUFACTURER FINAL INSPECTION  performed by:

Print or type name and title

Date

Signature

Designer Representative present for Final Inspection:

Print or type name and title

Owner Representative present for Final Inspection: (when practical)

Print or type name and title
1. Owner shall provide the Manufacturer with written notice within thirty (30) days of the discovery of any leak(s) in the roof system.

2. The Manufacturer shall within fourteen (14) calendar days, commencing with receipt of written notice from the Owner, inspect the roofing system in the presence of the Owner's representative (when practical) and if the cause(s) of the leak(s) is found the responsibility of the Manufacturer under this warranty, promptly make or cause to be made, the repair(s) or replacements(s) necessary to return the roofing system to the condition which is watertight and remediate moisture. All repair expenses incurred in connection herewith will be the responsibility of and borne by the Manufacturer.

3. If upon joint inspection by the Manufacturer and the Owner's representative of the roofing system as provided in Paragraph 2, the cause(s) of any leak(s) is found not the responsibility of the Manufacturer under this warranty, the Manufacturer will immediately advise the Owner of the type and extent of repair(s) required to be made at the Owner's expense and if such repair(s) be promptly and reasonably made by the Manufacturer, this warranty will remain in effect for the unexpired portion of the warranty period; otherwise, this warranty will become null and void with respect to the area(s) or item(s) affected.

4. In the event the Manufacturer and Owner disagree as to the cause(s) and responsibility of the leak(s), then the Owner, without prejudice to any other remedy Owner may have, may make repair(s) of any leak(s) in accordance with Manufacturer recommendations if timely made available. Such action by the Owner shall not constitute a violation of this warranty. The Owner reserves the right to pursue reimbursement from the Manufacturer for all cost(s) and expense(s) of such repair(s), subject to the Manufacturer's responsibility under this warranty. If it is determined that the Manufacturer has no responsibility for the leak(s) under this warranty, the Owner will reimburse the Manufacturer for direct expenses encountered for trips requested by the Owner after the initial inspection.

5. In the event an emergency condition arises where, in the reasonable opinion of the Owner immediate reasonable repair(s) are necessary to avoid substantial damage to the building or its contents and the Manufacturer advises the Owner in writing of its inability, for reasons beyond its control, to inspect and repair the roof system as necessary within fourteen (14) days of written notification from the Owner, then the Owner may make such temporary repair(s) as in the opinion of the Owner are essential and necessary and such action by the Owner shall not constitute a violation of this warranty. In these circumstances, the Manufacturer shall reimburse the Owner for all reasonable costs and expenses of such temporary repair(s) subject to the Manufacturer's responsibility under this warranty.

6. In the event the Manufacturer fails to respond to written notification of known or suspected leak(s) as provided in Paragraph 2, the Owner may, after fourteen (14) days following receipt by the Manufacturer of an additional written notice and without prejudice to any other remedy he may have, make permanent repair(s) of any leak(s) and recover all reasonable costs and expenses of such repair(s) from the Manufacturer. The Manufacturer will, upon demand by the Owner, promptly reimburse the Owner these reasonable repair costs and expenses. Such action by the Owner shall in no way negate the responsibilities of the Manufacturer under this warranty for the unexpired portion of the warranty period.

7. Except as provided in Paragraphs 4, 5 & 6, any alterations of the roofing system after completion and acceptance including the placement of fixtures, utilities and equipment on or through the roof or additions thereto, will render this warranty null and void with respect to the area(s) or item(s) affected unless prior written authorization of such alterations of the roof system or additions thereto is given by the Manufacturer. Such authorization will not be unreasonably withheld.

8. This warranty shall not be applicable to the extent the roofing system sustains damage(s) by any of the following:
(a) Acts of God and natural disasters, including but not limited to lightning, hurricanes, tornadoes, and earthquakes, winds of (3 second) peak gust speeds of 72 MPH or higher (determined by the nearest US Weather Station measured at 10 meters above ground or at the given address if reliable pinpoint wind data is available for the address), hail with a diameter greater than two inches;
(b) Acts of negligence (whether of omission or commission), fire, accidents, or misuse, including but not limited to vandalism, civil disobedience, or acts of war, provided same are not caused by the Manufacturer and/or the Contractor.
(c) Failure by the Owner to use reasonable care in maintaining the roof and appurtenances, provided same caused the leak(s) or item(s) affected; or,
(d) For built-up and modified bitumen roofs: A roof design or specification authorized by the Owner with less than 1/8" per foot slope for drainage.
(e) Building design issues that affect the performance of the Total Roofing System.

9. When the roof system has been damaged by any of the foregoing causes, repair(s) shall be at the Owner's expense and such repair(s) shall be made as provided in Paragraph 3; otherwise, this warranty will become null and void with respect to the area(s) or item(s) affected.
10. Until such time as the third year of this warranty has expired, the Manufacturer's obligations hereunder shall be joint and several with the Contractor. For the purpose of this paragraph, all of the Contractor's actions, whether of omission or commission, that are subject to this warranty are likewise the actions of the Manufacturer hereunder and shall in no way negate or reduce the responsibilities of the Manufacturer under this warranty.

11. As part of the repair of leaks, the Manufacturer shall replace roof insulation included in the this warranty that become damaged as a result of a roof leak, provided the roof leak is not excluded under the Terms, Conditions, and Limitations set forth in this warranty. The replacement of damaged roof insulation shall be limited to those boards that have lost the structural integrity necessary to support and restrain the System when it is subjected to dynamic loads such as typical roof service traffic, winds up to 72 mph, hail up to two inches in diameter, and periodic accumulations of water, snow, or ice. In the event that roof insulation is damaged as a result of a roof leak excluded under the Terms, Conditions and Limitations set forth in this warranty, the Manufacturer will advise the Owner of the type and extent of insulation and recovery board replacement to be made at the Owner's expense. Failure by the Owner to properly make these repairs in a reasonable manner using a Manufacturer licensed applicator and within a reasonable period of time shall render this Warranty null and void in the area of the damage. Neither the Manufacturer nor the Owner shall have any obligation to replace roof insulation and recovery board if the area affected by the leak is less than fifty (50) square feet.

12. The Manufacturer certifies that it:
   (a) Manufacturers or purchases products for the purpose of designing, developing, and marketing a roof system;
   (b) Provides recommendations, specifications, and details for the roofing system materials and installation;
   (c) Trains and authorizes Roofing Contractors;
   (d) Provides technical assistance to Roofing Contractors;
   (e) Approves or prepares shop drawings; and,
   (f) Provides a technical representative employed by the Manufacturer for the final inspection, and to all inspections required by this warranty.

13. During the period of this warranty, the Manufacturer, its agents or employees, will have free access to the roof during regular business hours of the Owner.

14. Owner shall be responsible for the costs associated with the removal and replacement, as well as any damage caused by the removal and replacement of any overburden, super strata, or overlays, either permanent or temporary, excluding accepted stone ballast or pavers, as necessary to expose the system for inspection and/or repair.

15. Alterations or repairs to the System that are not completed in accordance with Manufacturer's published specifications, not completed by an authorized contractor, and/or where current notification procedures were not followed are excluded and this warranty will become null and void with respect to the area(s) or item(s) affected.

16. For a 30 year single ply membrane roof system, the Total Roofing System Warranty shall cover the proper repair of leaks caused by unintentional, accidental and occasional puncture damage to the membrane as a result of normal rooftop inspection, maintenance or service; however, it does not cover damage caused by snow removal or damage caused by other trades during construction. There shall be no man hour limitation per year on accidental puncture repairs covered by this provision of the warranty. Resulting wet insulation shall be treated as set forth in Paragraph 11 above.

TOTAL ROOFING SYSTEM MANUFACTURER

Roofing System Manufacturer name

Authorized Signature & Date

Print or Type Name & Title
SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Manufactured through-wall flashing with counterflashing.
   2. Roof repair underlayment
   3. Roof Flashing
   4. Gutters and Downspouts

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: For sheet metal flashing and trim.
   1. Include plans, elevations, sections, and attachment details.
   2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
   3. Include identification of material, thickness, weight, and finish for each item and location in Project.
   4. Include details for forming, including profiles, shapes, seams, and dimensions.
   5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
   6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches (1:5).

C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

D. Samples for Verification: For each type of exposed finish.
   1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
   2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
   3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
   4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.5 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For fabricator.
   B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.
   C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
   D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS
   A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.7 QUALITY ASSURANCE
   A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
      1. For copings and roof edge flashings that are SPRI ES-1 tested and FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.
   B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
1. Build mockup of typical roof edge, including built-in gutter fascia fascia trim, approximately 10 feet (3.0 m) long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of
connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. **Temperature Change:** 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 **SHEET METALS**

A. **General:** Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. **Copper Sheet:** ASTM B 370, cold-rolled copper sheet, H00 or H01 temper.

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. [Hussey Copper Ltd](#).
   b. [Revere Copper Products, Inc](#).

2. **Nonpatinated Exposed Finish:** Mill.

3. **Nonpatinated, Exposed, Lacquered Finish:** Finish designations for copper alloys comply with system defined in NAAMM's "Metal Finishes Manual for Architectural and Metal Products."
   a. **Brushed Satin (Lacquered):** M32-06x (Mechanical Finish: directionally textured, medium satin; with clear organic coating); coating of "Incralac," waterborne, methyl methacrylate copolymer lacquer with UV inhibitor, applied by air spray in two coats per manufacturer's written instructions to total thickness of 1 mil (0.025 mm).
   b. **Mirror Polished (Lacquered):** M22-06x (Mechanical Finish: buffed, specular; with clear organic coating); coating of "Incralac," waterborne, air-drying, methyl methacrylate copolymer lacquer with UV inhibitor, applied by air spray in two coats per manufacturer's written instructions to total thickness of 1 mil (0.025 mm).

4. **Prepatinated Copper-Sheet Finish:** Dark brown, prepatinated according to ASTM B 882.

C. **Stainless-Steel Sheet:** ASTM A 240/A 240M, Type 304, dead soft, fully annealed; with smooth, flat surface.

1. **Finish:** 4 (polished directional satin).

2.3 **UNDERLAYMENT MATERIALS**

A. **Felt:** ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated. Before retaining "Synthetic Underlayment" Paragraph below, verify that it is acceptable to authorities having jurisdiction; revise to suit Project. Revise if high-temperature underlayment is not required. Slopes are typically limited to not less than 2:12 according to manufacturers' published literature. Verify, with underlayment manufacturer, acceptability of use on shallower slopes.
B. Self-Adhering, High-Temperature Sheet: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

1. **Basis-of-Design Product**: Subject to compliance with requirements, provide Grace Construction Products; W.R. Grace & Co. -- Conn.; Grace Ice and Water Shield HT or a comparable product by one of the following:
   - Carlisle Coatings & Waterproofing Inc.
   - Carlisle Residential; a division of Carlisle Construction Materials.
   - Owens Corning.

2. **Thermal Stability**: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.
3. **Low-Temperature Flexibility**: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.

C. **Slip Sheet**: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

### 2.4 MISCELLANEOUS MATERIALS

A. **General**: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. **Fasteners**: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. **General**: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
   a. **Exposed Fasteners**: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
   b. **Blind Fasteners**: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
   c. **Spikes and Ferrules**: Same material as gutter; with spike with ferrule matching internal gutter width.

2. **Fasteners for Copper Sheet**: Copper, hardware bronze or passivated Series 300 stainless steel.
3. **Fasteners for Aluminum Sheet**: Aluminum or Series 300 stainless steel.
4. **Fasteners for Stainless-Steel Sheet**: Series 300 stainless steel.
5. **Fasteners for Zinc-Tin Alloy-Coated Stainless-Steel Sheet**: Series 300 stainless steel.
6. **Fasteners for Zinc-Coated (Galvanized) Alloy-Coated Steel Sheet**: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
7. **Fasteners for Zinc Sheet**: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

C. **Solder:**
1. For Copper: ASTM B 32, with maximum lead content of 0.2 percent.
2. For Stainless Steel: ASTM B 32, Grade Sn96, with acid flux of type recommended by stainless-steel sheet manufacturer.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.


2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.

1. **Basis-of-Design Product**: Subject to compliance with requirements, provide Fry Reglet Corporation; Reglet MA or a comparable product by one of the following:
   a. Cheney Flashing Company
   b. Heckmann Building Products, Inc.
   c. Hickman Company, W. P.
   d. Hohmann & Barnard, Inc.
   e. Keystone Flashing Company, Inc.
   f. National Sheet Metal Systems, Inc.

2. Material: Copper, 16 oz./sq. ft. (0.55 mm thick).
3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
4. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
5. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
6. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
7. Accessories:
a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.

b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing’s lower edge.


2.6 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA’s "Guide Specification for Residential Metal Roofing."

D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

E. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
I. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

J. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.

K. Do not use graphite pencils to mark metal surfaces.

2.7 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch (2400-mm) long sections. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.

1. Gutter Profile: match existing building and according to cited sheet metal standard.
2. Expansion Joints: Lap type.
3. Accessories: Wire-ball downspout strainer.
4. Gutters with Girth up to 15 Inches (380 mm): Fabricate from the following materials:
   a. Copper: 16 oz./sq. ft. (0.55 mm thick) where tying into existing roof gutter system – verify compatibility.
5. Gutters with Girth 16 to 20 Inches (410 to 510 mm): Fabricate from the following materials:
   a. Copper: 16 oz./sq. ft. (0.55 mm thick). – verify compatibility with existing sheet metal.
6. Gutters with Girth 21 to 25 Inches (530 to 640 mm): Fabricate from the following materials:
   a. Copper: 20 oz./sq. ft. (0.68 mm thick). verify compatibility with existing sheet metal.
7. Gutters with Girth 26 to 30 Inches (660 to 760 mm): Fabricate from the following materials:
   a. Copper: 24 oz./sq. ft. (0.82 mm thick).
   b. Aluminum: 0.063 inch (1.60 mm) thick.
   c. Stainless Steel: 0.031 inch (0.79 mm) thick.
   d. Galvanized Steel: 0.040 inch (1.02 mm) thick.
8. Gutters with Girth 31 to 35 Inches (790 to 890 mm): Fabricate from the following materials:
   a. Copper: 24 oz./sq. ft. (0.82 mm thick). verify compatibility with existing sheet metal.

B. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Fabricated Hanger Style: to match existing downspouts to remain and according to SMACNA's "Architectural Sheet Metal Manual."
   a. Copper: 16 oz./sq. ft. (0.55 mm thick).
C. Splash Pans: Fabricate to dimensions and shape required and from the following materials:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Aluminum: 0.040 inch (1.02 mm) thick.
3. Stainless Steel: 0.019 inch (0.48 mm) thick.

2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates. Shop fabricate interior and exterior corners.

1. Joint Style: Overlapped, 4 inches (100 mm) wide with concealed backup plate.
2. Fabricate with scuppers spaced 10 feet (3 m) apart, to dimensions required with 4-inch- (100-mm-) wide flanges and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
3. Fabricate from the Following Materials:
   a. Copper: 20 oz./sq. ft. (0.68 mm thick).
   b. Aluminum: 0.040 inch (1.02 mm) thick.
   c. Stainless Steel: 0.019 inch (0.48 mm) thick.

B. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, solder or weld watertight. Shop fabricate interior and exterior corners.

1. Coping Profile: as indicated on drawings
2. Joint Style: Butted with expansion space and 6-inch- (150-mm-) wide, concealed backup plate.
3. Fabricate from the Following Materials:
   a. Copper: 24 oz./sq. ft. (0.82 mm thick).
   b. Stainless Steel: 0.025 inch (0.64 mm) thick.

C. Roof and Roof-to-Wall Transition Roof-to-Roof Edge-Flashing (Gravel-Stop) Transition Roof-to-Roof Edge-Flashing and Fascia-Cap Transition Expansion-Joint Cover: Fabricate from the following materials: Shop fabricate interior and exterior corners.

1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Stainless Steel: 0.025 inch (0.64 mm) thick.

D. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Copper: 20 oz./sq. ft. (0.68 mm thick).
2. Stainless Steel: 0.019 inch (0.48 mm) thick.
3. Copper-Clad Stainless Steel: 0.018 inch (0.46 mm) thick.

E. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Stainless Steel: 0.019 inch (0.48 mm) thick.
3. Copper-Clad Stainless Steel: 0.018 inch (0.46 mm) thick.

F. Flashing Receivers: Fabricate from the following materials:
1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Stainless Steel: 0.016 inch (0.40 mm) thick.
3. Copper-Clad Stainless Steel: 0.016 inch (0.40 mm) thick.

G. Roof-Penetration Flashing: Fabricate from the following materials:
1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Stainless Steel: 0.019 inch (0.48 mm) thick.
3. Copper-Clad Stainless Steel: 0.018 inch (0.46 mm) thick.

H. Roof-Drain Flashing: Fabricate from the following materials:
1. Copper: 12 oz./sq. ft. (0.41 mm thick).
2. Stainless Steel: 0.016 inch (0.40 mm) thick.
3. Copper-Clad Stainless Steel: 0.016 inch (0.40 mm) thick.

2.9 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:
1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Stainless Steel: 0.016 inch (0.40 mm) thick.
3. Copper-Clad Stainless Steel: 0.016 inch (0.40 mm) thick.

B. Valley Flashing: Fabricate from the following materials:
1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Stainless Steel: 0.019 inch (0.48 mm) thick.
3. Copper-Clad Stainless Steel: 0.018 inch (0.46 mm) thick.

C. Drip Edges: Fabricate from the following materials:
1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Stainless Steel: 0.016 inch (0.40 mm) thick.
3. Copper-Clad Stainless Steel: 0.016 inch (0.40 mm) thick.

D. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:
1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Stainless Steel: 0.016 inch (0.40 mm) thick.
3. Copper-Clad Stainless Steel: 0.016 inch (0.40 mm) thick.

E. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Stainless Steel: 0.019 inch (0.48 mm) thick.
3. Copper-Clad Stainless Steel: 0.018 inch (0.46 mm) thick.

F. Flashing Receivers: Fabricate from the following materials:
1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Stainless Steel: 0.016 inch (0.40 mm) thick.
3. Copper-Clad Stainless Steel: 0.016 inch (0.40 mm) thick.

G. Roof-Penetration Flashing: Fabricate from the following materials:
1. Copper: 16 oz./sq. ft. (0.55 mm thick).
2. Stainless Steel: 0.019 inch (0.48 mm) thick.
3. Copper-Clad Stainless Steel: 0.018 inch (0.46 mm) thick.

2.10 WALL SHEET METAL FABRICATIONS

A. Drip Edge for Embedded Flashings (04 20 00 – Unit Masonry): Fabricate continuous drip edges in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
1. Stainless Steel: 0.016 inch (0.40 mm) thick.

2.11 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:
1. Galvanized Steel: 0.028 inch (0.71 mm) thick.

B. Overhead-Piping Safety Pans: Fabricate from the following materials:
1. Galvanized Steel: 0.040 inch (1.02 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers’ written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

D. Apply slip sheet, wrinkle free, directly on substrate before installing sheet metal flashing and trim.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.
6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.
   1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
   2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work.
   1. Do not solder metallic-coated steel and aluminum sheet.
   2. Do not pre-tin zinc-tin alloy-coated stainless steel and zinc-tin alloy-coated copper.
   3. Do not use torches for soldering.
   4. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
   5. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
   7. Copper-Clad Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for copper-clad stainless steel.

H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.
   1. Fasten gutter spacers to front and back of gutter.
   2. Anchor and loosely lock back edge of gutter to continuous eave or apron flashing.
3. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches (600 mm) apart.
4. Anchor gutter with gutter brackets spaced not more than 24 inches (600 mm) apart to roof deck, unless otherwise indicated, and loosely lock to front gutter bead.
5. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet (15.24 m) apart. Install expansion-joint caps.

C. Built-in Gutters: Join sections with riveted and soldered joints. Provide for thermal expansion. Slope to downspouts. Provide end closures and seal watertight with sealant.

1. Install underlayment layer in built-in gutter trough and extend to drip edge at eaves and under underlayment on roof sheathing. Lap sides minimum of 2 inches (50 mm) over underlying course. Lap ends minimum of 4 inches (100 mm). Stagger end laps between succeeding courses at least 72 inches (1830 mm). Fasten with roofing nails. Install slip sheet over underlayment.
2. Anchor and loosely lock back edge of gutter to continuous eave or apron flashing.
3. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 18 inches (460 mm) apart.
4. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet (15.24 m) apart. Install expansion-joint caps.

D. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints.

1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c.
2. Provide elbows at base of downspout to direct water away from building.
3. Connect downspouts to underground drainage system.

E. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in compatible with the substrate.

F. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints minimum of 4 inches (100 mm) in direction of water flow.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.

C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints minimum of 4 inches (100 mm). Secure in waterproof
manner by means of snap-in installation and sealant or lead wedges and sealant interlocking folded seam or blind rivets and sealant unless otherwise indicated.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 042000 "Unit Masonry." Section 044200 "Exterior Stone Cladding."

C. Reglets: Installation of reglets is specified in Section 042000 "Unit Masonry."

D. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

3.7 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.8 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.9 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.
D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00
SECTION 07 72 73 - MEMBRANE LEAK DETECTION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: waterproofing leak detection system, including the following:
   1. Detection system conductor cable and accessories.
   2. Measurement grid for leak detection system.
   3. Leak detection testing of installed membrane.

B. Related Sections
   1. Division 01 Sections for general requirements.
   2. Division 07 Waterproofing section for coordination and quality assurance provisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Integrate layout of membrane leak detection test system with rooftop structures and equipment and roof penetrations for building utilities and services.
   2. Coordinate membrane leak detection system with work of other Sections.

B. Preinstallation Meetings: Conduct preinstallation meeting in coordination with the waterproofing preinstallation conference to verify project requirements, manufacturer’s installation instructions, and coordination with installation requirements horizontal waterproofing assemblies.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product required for a complete leak detection system.

B. Shop Drawings: Showing the following.
   1. Diagram of proposed system showing complete test area, rooftop structures and equipment, and roof penetrations for building utilities and services. Show location of the leak detection system test conductor cable, measurement grid, and connection boxes.

1.5 INFORMATIONAL SUBMITTALS

A. Qualifications: For manufacturer and installing and testing firm.

B. Field Quality Control Reports: Digital drawings, digital photographic documentation, and written report detailing location and nature of membrane breaches, defects found, and verification of corrective actions taken.

1.6 CLOSEOUT SUBMITTALS

A. Record Drawings: Digital drawings, photographic documentation, and written report detailing installed location of components of membrane integrity test system.
1.7 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer of membrane leak detection systems with minimum ten year record of satisfactory manufacturing and support of installed systems comparable to system required as Work of this Section. Manufacturer shall be compatible with waterproofing assembly manufacturer's warranty requirements.

B. Installing and Testing Firm Qualifications: Approved or certified by membrane leak detection system manufacturer, with minimum five year record of satisfactory experience.

1.8 CORRECTION PERIOD SERVICES

A. Perform field quality control testing at end of one year period for correction of Work. Testing service shall include construction, disturbance and repair of project as required to achieve testing in coordination with the waterproofing assembly manufacturer.
   1. Repair defects in membrane and retest to demonstrate membrane integrity.
   2. Submit test and retest reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide membrane integrity test system and service by International Leak Detection (ILD), (866) 282-LEAK, ((866) 282-5325), info@leak-detection.com or comparable system and service from another manufacturer, with the following characteristics.

B. Other manufacturers include but are not limited to:
   1. Detec Electronic Leak Detection (855) 753-3832 www.detecsystems.com
   2. IR Analyzers Vector Mapping 1-800-879-1964 www.iranalyzers.com

2.2 SYSTEM DESCRIPTION

A. Membrane Leak Detection System: Conductor cable, placed on top of membrane, delivering direct current tension to membrane surface, enabling inspection and isolation of points of moisture infiltration through membrane to conductive substrate under membrane.
   1. Measurement Grid: Highly conductive stainless steel wire measurement grid located under membrane and above non-conductive membrane substrate, connected through contact plate and cable to connection box accepting applied low-voltage charge from portable pulse generator.

2.3 MATERIALS

A. Conductor Cable: Nine strands of 0.06 inch (1.5 mm) diameter highly-conductive stainless steel wire interwoven with braided polyethylene strands, placed on weather side of membrane:

B. Measurement Grid: Highly conductive, corrosion resistant, geometrically stable mesh placed between membrane and protected building components.
   1. Stainless steel grid: 2 by 2 inch (50 by 50 mm) screen mesh in 47 inch by 160 foot (1.2 by 50 m) rolls.

C. Conductor Wire Assembly: Provide grounding plate for connection to measurement grid, suitable for connection to terminals at connection box.
D. Connection Box: Weatherproof, corrosion-resistant electrical enclosure with permanent terminal connections for connecting diagnostic and testing equipment, NEMA 4X with the following characteristics:
1. Permanent connections for attachment of diagnostic and testing equipment without opening contact box.
2. Weatherproof cover to seal terminals when membrane integrity test system is not in use.
3. Hardware, brackets, and fittings required to permanently mount contact box to building structure.

2.4 ACCESSORIES

A. Provide corrosion-resistant fasteners and hardware, electrical terminations, sealants, and other items required to provide complete installation.

B. Lap Joint Tape: Provide self adhesive aluminum tape, minimum 2 inch (50 mm) wide.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examination: Verify that substrate complies with roofing manufacturer's and integrity test manufacturer's requirements. Proceed with installation once substrate complies with requirements.

3.2 INSTALLATION

A. Measurement Grid: Install measurement on membrane substrate immediately under membrane and immediately prior to installation of membrane.
1. Verify that location of measurement grid fasteners does not interfere with or cause damage to membrane.
2. Fasten measurement grid in accordance with leak detection system manufacturer's requirements.
3. Do not place measurement grid where it will be in continuous direct contact with structural components.
4. Provide minimum 2 inch (50 mm) overlap where adjacent sheets meet, including side laps and end laps.
5. Cut measurement grid as close as possible to the perpendicular strand at both end and side edges

B. Conductor Wire: Install conductor wire on top of membrane at spacing and layout indicated on approved shop drawings.
1. Secure conductor wire using method recommended by manufacturer.

C. Installation Testing: Verify continuity and functioning of conductor wire and measurement grid upon completion of installation.

3.3 FIELD QUALITY CONTROL

A. Contractor shall engage qualified Installation and Testing Firm to perform membrane integrity testing. Perform testing in accordance with membrane integrity test system manufacturer's recommendations.
1. Perform testing following adequate precipitation or wet membrane and membrane overburden adequately to enable accurate testing.
2. Identify locations of membrane leaks; record locations and document with photographs. Submit test reports to Architect.
3. Confirm completed repair of identified leaks and retest to verify water tightness of membrane.

B. Initial Membrane Test: Perform initial membrane integrity test test upon completion of membrane and integrity test system installation and prior to installation of above-membrane components.
C. Assembly Test: Repeat membrane integrity test following installation of above-membrane components.

D. Final Testing: Repeat membrane integrity test if roof assembly is exposed to traffic or construction operations prior to Substantial Completion.

3.4 PROTECTION

A. Protect tested membrane according to requirements of Division 07 waterproofing section.

B. Prevent construction traffic and activities on completed and tested membrane. Retest membranes exposed to construction activities.

END OF SECTION 07 72 73
SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Penetrations in fire-resistance-rated walls.
   2. Penetrations in horizontal assemblies.
   3. Penetrations in smoke barriers.

B. Related Requirements:
   1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.3 ALLOWANCES

A. Penetration firestopping Work is part of an allowance.

1.4 UNIT PRICES

A. Work of this Section is affected by unit prices.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.
1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.7 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.10 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.

2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."
3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

   a. 3M Fire Protection Products.
   c. Grabber Construction Products.
   d. Hilti, Inc.
   e. STC Architectural Products.
   f. Tremco, Inc.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration
firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.


2.4 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time,
and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

   1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor’s name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer’s name.
6. Installer’s name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.
3.7 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under "Firestop Systems."

C. Where FM Global-approved systems are indicated, they refer to design numbers listed in FM Global's "Building Materials Approval Guide" under "Wall and Floor Penetration Fire Stops."

D. Penetration Firestopping Systems with No Penetrating Items:
   1. UL-Classified Systems: as indicated on drawings and as required to meet rated assembly requirements.
   2. Intertek Group-Listed Systems: equal to UL system specified above.
   3. FM Global-Approved Systems: equal to UL system specified above.

E. Penetration Firestopping Systems for Metallic Pipes, Conduit, or Tubing:
   1. UL-Classified Systems: as indicated on drawings and as required to meet rated assembly requirements.
   2. Intertek Group-Listed Systems: equal to UL system specified above.
   3. FM Global-Approved Systems: equal to UL system specified above.

F. Penetration Firestopping Systems for Nonmetallic Pipe, Conduit, or Tubing:
   1. UL-Classified Systems: as indicated on drawings and as required to meet rated assembly requirements.
   2. Intertek Group-Listed Systems: equal to UL system specified above.
   3. FM Global-Approved Systems: equal to UL system specified above.

G. Penetration Firestopping Systems for Electrical Cables:
   1. UL-Classified Systems: as indicated on drawings and as required to meet rated assembly requirements.
   2. Intertek Group-Listed Systems: equal to UL system specified above.
   3. FM Global-Approved Systems: equal to UL system specified above.

H. Penetration Firestopping Systems for Cable Trays with Electric Cables:
   1. UL-Classified Systems: as indicated on drawings and as required to meet rated assembly requirements.
   2. Intertek Group-Listed Systems: equal to UL system specified above.
   3. FM Global-Approved Systems: equal to UL system specified above.

I. Penetration Firestopping Systems for Insulated Pipes:
   1. UL-Classified Systems: as indicated on drawings and as required to meet rated assembly requirements.
   2. Intertek Group-Listed Systems: equal to UL system specified above.
   3. FM Global-Approved Systems: equal to UL system specified above.

J. Penetration Firestopping Systems for Miscellaneous Electrical Penetrants:
   1. UL-Classified Systems: as indicated on drawings and as required to meet rated assembly requirements.
2. Intertek Group-Listed Systems: equal to UL system specified above.
3. FM Global-Approved Systems: equal to UL system specified above.

K. Penetration Firestopping Systems for Miscellaneous Mechanical Penetrants:
   1. UL-Classified Systems: as indicated on drawings and as required to meet rated assembly requirements.
   2. Intertek Group-Listed Systems: equal to UL system specified above.
   3. FM Global-Approved Systems: equal to UL system specified above.

L. Penetration Firestopping Systems for Groupings of Penetrants:
   1. UL-Classified Systems: as indicated on drawings and as required to meet rated assembly requirements.
   2. Intertek Group-Listed Systems: equal to UL system specified above.
   3. FM Global-Approved Systems: equal to UL system specified above.

END OF SECTION 07 84 13
SECTION 07 84 43 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
   1. Joints in or between fire-resistance-rated constructions.
   2. Joints in smoke barriers.
B. Related Requirements:
   1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.
   2. Section 092216 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1.4 INFORMATIONAL SUBMITTALS
A. Qualification Data: For Installer.
B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS
A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.
1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.

2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

   a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

      1) UL in its "Fire Resistance Directory."
      2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
1. **Basis-of-Design Product**: Subject to compliance with requirements, provide [3M Fire Protection Products](#); product name or designation or a comparable product by one of the following:
   a. [Roxul Inc](#).
   b. [Thermafiber, Inc.; an Owens Corning company](#).

2. **Fire-Resistance Rating**: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

C. **Joints in Smoke Barriers**: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).

   1. **Basis-of-Design Product**: Subject to compliance with requirements, provide [3M Fire Protection Products](#); or a comparable product by one of the following:
      a. [Roxul Inc](#).
      b. [Thermafiber, Inc.; an Owens Corning company](#).

   2. **L-Rating**: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at both ambient and elevated temperatures.

D. **Exposed Joint Firestopping Systems**: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. **Accessories**: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

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**PART 3 - EXECUTION**

3.1 **EXAMINATION**

   A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 **PREPARATION**

   A. **Surface Cleaning**: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
      1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
      2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
      3. Remove laitance and form-release agents from concrete.
B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.
3.6 CLEANING AND PROTECTION

A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 07 84 43
SECTION 07 91 00 - PREFORMED JOINT SEALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Preformed, foam joint seals.
   2. Precured, extruded-silicone joint seals.

B. Related Requirements:
   1. Section 079200 "Joint Sealants" for liquid sealants applied over preformed seals in dual seal systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each preformed joint seal product.

B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of preformed joint seal required, provide Samples with joint seals in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint seals.

D. Preformed Joint Seal Schedule: Include the following information:
   1. Joint seal location and designation.
   2. Joint width and movement capability.
   3. Joint seal manufacturer and product name.
   4. Joint seal color.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each preformed joint seal for tests performed by manufacturer and witnessed by a qualified testing agency.

B. Warranties: For special warranties.
1.5 QUALITY ASSURANCE

A. Mockups: Install mockups of assemblies specified in other Sections that are indicated to receive preformed joint seals specified in this Section. Use materials and installation methods specified in this Section.

1.6 WARRANTY

A. Special Warranty: Installer agrees to repair or replace preformed joint seals that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish preformed joint seals to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PREFORMED, FOAM JOINT SEALS

A. Preformed, Foam Joint Seals: At construction joint of new plaza deck to existing brick wall on south side of building.

1. Basis-of-Design Product: Subject to compliance with requirements, provide EMSEAL; DSM System or a comparable product by other manufacturer's with advanced approval by Architect.

2. Design Criteria:

   a. Nominal Joint Width: 1/2-inch.
   b. Movement Capability: -50 percent/+50 percent.
   c. Sealant system shall be comprised of three components: 1) cellular polyurethane foam impregnated with hydrophobic 100% acrylic, water-based emulsion, factory coated with highway-grade, fuel resistant silicone; 2) field-applied epoxy adhesive primer, 3) field-injected silicone sealant bands.
   d. Preformed joint seal to be installed into manufacturer's standard field-applied epoxy adhesive.
   e. Preformed joint seal is to be installed slightly recessed from the surface such that when the field-applied injection band of silicone is installed between the substrates and the foam-and-silicone-bellows, the system will be essentially flush with the substrate surface.
   f. Select the sealant system model appropriate to the movement and design requirements at each joint location that meet the project specification or as defined by the structural engineer of record.
   g. Manufacturer’s Checklist must be completed by expansion joint subcontractor and returned to manufacturer at time of ordering material.
3. Joint Seal Color: As selected by Architect from full range of industry colors.

2.2 EXTRUDED-SILICONE JOINT SEALS

A. Extruded-Silicone Joint Seals: Manufacturer's standard seal consisting of precured low-modulus silicone extrusion, with a neutral-curing silicone sealant for bonding extrusions to substrates.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Dow Corning Corporation; Dow Corning® 123 Silicone Seal. or a comparable product by one of the following:
   a. Pecora Corporation.
   b. Sika Corporation; Joint Sealants.
   c. Tremco Incorporated.

2. Joint Seal Width: Joint size indicated on Drawings plus 0.75 inch (19 mm).
3. Joint Seal Color: As selected by Architect from full range of industry colors.

2.3 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by preformed-joint-seal manufacturer for joint substrates indicated.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to preformed joint seal manufacturer, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces, and formulated to promote best adhesion to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with preformed joint seals and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive preformed joint seals, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting preformed-joint seal performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing preformed joint seals to comply with preformed joint seal manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of preformed joint seal, including dust, paints (except for permanent protective coatings tested and approved for seal adhesion and compatibility by seal manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimal bond with preformed joint seals. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
   a. Concrete.
   b. Masonry.
   c. Unglazed surfaces of ceramic tile.
   d. Exterior insulation and finish systems.

3. Remove laitance and form-release agents from concrete.

4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint seals. Nonporous joint substrates include the following:
   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by preformed joint seal manufacturer or as indicated by tests or prior experience. Apply primer to comply with joint seal manufacturer's written instructions. Confine primers to areas of joint seal bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of adhesive or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

A. General: Comply with preformed joint seal manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Installation of Preformed, Foam Joint Seals:
   1. Install each length of seal immediately after removing protective wrapping.
   2. Firmly secure compressed joint seals to joint gap side to obtain full bond using exposed pressure-sensitive adhesive or field-applied adhesive as recommended by manufacturer.
   3. Do not pull or stretch material. Produce seal continuity at splices, ends, turns, and intersections of joints.
   4. For applications at low ambient temperatures, heat foam joint seal material in compliance with manufacturer's written instructions.
   5. No drilling, or screwing, or fasteners of any type are permitted to anchor the sealant system into the substrate.
   6. System to be installed by qualified sub-contractors only according to detailed published installation procedures and/or in accordance with job-specific installation instructions of manufacturer’s field technician.
C. Installation of Precured, Extruded-Silicone Joint Seals:

1. Apply masking tape to each side of joint, outside of area to be covered by seal system.
2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone seal system manufacturer’s written instructions and covering a bonding area of not less than 3/8 inch (10 mm). Hold edge of sealant bead 1/4 inch (6 mm) inside masking tape.
3. Press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact with substrate.
4. Complete installation of seal system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.

3.4 PROTECTION

A. Protect preformed joint seals from damage resulting from construction operations or other causes so seals are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated seals immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 91 00
SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Silicone joint sealants.
   2. Nonstaining silicone joint sealants.
   3. Urethane joint sealants.
   4. Immersible joint sealants.
   5. Silyl-terminated polyether joint sealants.
   7. Polysulfide joint sealants.
   8. Butyl joint sealants.
   9. Latex joint sealants.

B. Related Requirements:
   1. Section 079100 "Preformed Joint Seals" for preformed compressible foam and precured joint seals.
   2. Section 079219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Sustainable Design Submittals:
   1. Product Data: For sealants, indicating VOC content.
   2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

E. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.

C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
   1. Joint-sealant location and designation.
   2. Manufacturer and product name.
   3. Type of substrate material.
   5. Number of samples required.

D. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
   1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
   2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

E. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

F. Field-Adhesion-Test Reports: For each sealant application tested.

G. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.
   1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
1.6 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with stone and masonry substrates.
4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
      1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
4. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
5. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.7 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Silicone: Twenty years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
   1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
   2. Disintegration of joint substrates from causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content: Sealants and sealant primers shall comply with the following:
   1. Architectural sealants shall have a VOC content of 250 g/L or less.
   2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
   3. Sealants and sealant primers for nonporous substrates shall have a VOC content of 775 g/L or less.

C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range of at least six colors. Lack of approvable color selection shall be cause for rejection of product.
2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 100/50, NT, T: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use T, NT, SWRI validation.

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Dow Corning Corporation; Dow Corning® 790 Silicone Weatherproofing Sealant. or a comparable product by one of the following:
   a. GE Construction Sealants; Momentive Performance Materials Inc.
   b. Sika Corporation.
   c. Pecora Corporation.
   d. Tremco Commercial Sealants and Waterproofing

B. Silicone, S, NS, 50, NT, G, A, O: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT, G, A, O; SWRI validation

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Dow Corning Corporation; Dow Corning® 795 Silicone Weatherproofing Sealant. or a comparable product by one of the following:
   a. GE Construction Sealants; Momentive Performance Materials Inc.
   b. Sika Corporation.
   c. Pecora Corporation.
   d. Tremco Commercial Sealants and Waterproofing

2.3 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide DAP Dynaflex 230 or comparable product by one of the following:
   a. Dow Corning Corporation.
   b. GE Construction Sealants; Momentive Performance Materials Inc.

2.4 LATEX JOINT SEALANTS

A. Siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Pecora Corporation; AC-20. or a comparable product by one of the following:
2.5 URETHANE JOINT SEALANTS

A. Urethane, M, 25, NS, T, M, A, O. Multi-component, nonsag, traffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 25, Use T, M, A and O. Also approved for immersion.

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Pecora Corporation; DynaTred. or a comparable product by one of the following:
   
a. BASF Corporation; Construction Systems.

2.6 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide BASF Corporation; Construction Systems; MasterSeal 920 & 921(Pre-2014: Sonolastic Backer Rod). or a comparable product by one of the following:

   a. BASF Corporation; Construction Systems.

   B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

   C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
   a. Concrete.
   b. Masonry.
   c. Unglazed surfaces of ceramic tile.
   d. Exterior insulation and finish systems.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.
3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
      a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
   1. Extent of Testing: Test completed and cured sealant joints as follows:
      a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
      b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.
   
a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:
   
a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:
   a. Control and expansion joints in brick pavers.
b. Isolation and contraction joints in cast-in-place concrete slabs.
c. Joints between plant-precast architectural concrete paving units.
d. Joints in stone paving units, including steps.
e. Joints between different materials listed above.
f. Other joints as indicated on Drawings.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.


1. Joint Locations:
   b. Joints between plant-precast architectural concrete units.
   c. Control and expansion joints in unit masonry.
   d. Joints in dimension stone cladding.
   e. Joints in glass unit masonry assemblies.
   f. Joints in exterior insulation and finish systems.
   g. Joints between metal panels.
   h. Joints between different materials listed above.
   i. Perimeter joints between materials listed above and frames of doors windows and louvers.
   j. Control and expansion joints in ceilings and other overhead surfaces.
   k. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:
   b. Control and expansion joints in stone flooring.
   c. Control and expansion joints in brick flooring.
   d. Other joints as indicated on Drawings.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.


1. Joint Locations:
   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Tile control and expansion joints.
   c. Vertical joints on exposed surfaces of unit masonry concrete walls and partitions.
   d. Joints on underside of plant-precast structural concrete beams and planks.
   e. Other joints as indicated on Drawings.

2. Joint Sealant: Siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
E. Joint- SEALANT Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:
   a. Control joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
   c. Other joints as indicated on Drawings.

2. Joint Sealant: Siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
3. Joint-SEALANT Color: As selected by Architect from manufacturer's full range of colors.

F. Joint- SEALANT Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:
   a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   b. Tile control and expansion joints where indicated.
   c. Concealed at sill plates and thresholds
   d. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, Mildew Resistant, S, NS, 25, NT
3. Joint-SEALANT Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 07 92 00
SECTION 07 92 19 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes acoustical joint sealants.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for nonacoustical applications.

1.3 ACTION SUBMITTALS

A. Product Data: For each acoustical joint sealant.

B. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.

2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Samples for Initial Selection: Manufacturer’s color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

D. Samples for Verification: For each kind and color of acoustical joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

E. Acoustical-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.

2. Joint-sealant manufacturer and product name.


1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each kind of acoustical joint sealant, for tests performed by a qualified testing agency.
B. Sample Warranties: For special warranties.

1.5 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.

1. Sealant shall have a VOC content of 250 g/L or less.
2. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C 834.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. OSI Sealants; Henkel Corporation.
   b. Pecora Corporation.
   c. Tremco Incorporated.

2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.


1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Pecora Corporation.
   b. Serious Energy Inc.
2.3 MISCELLANEOUS MATERIALS

   A. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.

   B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

   C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

   A. Examine joints indicated to receive acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

   A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.

   B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

   C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

   A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

   B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

ACOUSTICAL JOINT SEALANTS
C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of acoustical joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect acoustical joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 92 19
SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes hollow-metal work.

B. Related Requirements:
   1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

B. Sustainable Design Submittals:
   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Include the following:
   1. Elevations of each door type.
   2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
   3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
   4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:
1. For "Doors" and "Frames" subparagraphs below, prepare Samples approximately 8 by 10 inches to demonstrate compliance with requirements for quality of materials and construction:
   a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
   b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

E. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
   1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Curries Company; ASSA ABLOY.
   2. Republic Doors and Frames.
   3. Steelcraft; an Allegion brand.
2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level B according to SDI A250.4.

2. Doors:

   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches (44.5 mm).
   c. Face: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
   d. Edge Construction: Model 2, Seamless.
   e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polysisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

3. Frames:

   a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
   b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
   c. Construction: Face welded.


2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:
   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches (44.5 mm.)
   c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
   d. Edge Construction: Model 2, Seamless.
   e. Core: Manufacturer's standard polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

   1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) when tested according to ASTM C 1363.

3. Frames:
   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
   b. Construction: Face welded.


2.5 BORROWED LITES

A. Hollow-metal frames of metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm).

B. Construction: Face welded.

2.6 HOLLOW-METAL PANELS

A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.7 FRAME ANCHORS

A. Jamb Anchors:
   1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
   2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
   3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
   4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.8 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

G. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

H. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

J. Glazing: Comply with requirements in Section 088000 "Glazing."

K. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.9 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble
units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
2. Fire Door Cores: As required to provide fire-protection and temperature-rise ratings indicated.
4. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
5. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: Provide number and spacing of anchors as follows:
   a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:
      1) Two anchors per jamb up to 60 inches (1524 mm) high.
      2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
      3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
      4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
   b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
      1) Three anchors per jamb up to 60 inches (1524 mm) high.
      2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
      3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.

c. Compression Type: Not less than two anchors in each frame.
d. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

6. Head Anchors: Two anchors per head for frames more than 42 inches (1067 mm) wide and mounted in metal-stud partitions.

7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

8. Terminated Stops: Terminate stops 6 inches (152 mm) above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
   1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
   2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.
   1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
   2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
   3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
   4. Provide loose stops and moldings on inside of hollow-metal work.
   5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.10 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
   1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
B. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with SDI A250.3.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.11 ACCESSORIES

A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch- (0.5-mm-) thick, cold-rolled steel sheet set into 0.032-inch- (0.8-mm-) thick steel frame.

1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
2. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other.
3. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same qualified testing and inspecting agency that established fire-resistance rating of door assembly.

B. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

C. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
   a. At fire-rated openings, install frames according to NFPA 80.
   b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   c. Install frames with removable stops located on secure side of opening.
   d. Install door silencers in frames before grouting.
   e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
   a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.


4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.

6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.

8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:
a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
c. At Bottom of Door: 3/4 inch (19.1 mm) plus or minus 1/32 inch (0.8 mm).
d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
   1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

F. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113
SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Solid-core doors and transom panels with wood-veneer and plastic-laminate faces.
   2. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:
   1. Section 06 20 23 "Interior Finish Carpentry" and Section 06 48 00 "Wood Frames" for wood door frames including fire-rated wood door frames.
   2. Section 088000 "Glazing" for glass view panels in flush wood doors.
   3. Section 09 90 00 "Painting" and Section 09 93 00 "Staining and Transparent Finishing" for field finishing doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction, louvers, and trim for openings.

B. Sustainable Design Submittals:
   1. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
   2. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
   1. Dimensions and locations of blocking.
   2. Dimensions and locations of mortises and holes for hardware.
   3. Dimensions and locations of cutouts.
   4. Undercuts.
   5. Requirements for veneer matching.
   6. Doors to be factory finished and finish requirements.
   7. Fire-protection ratings for fire-rated doors.

D. Samples for Initial Selection: For plastic-laminate door faces.
E. Samples for Verification:
   1. Corner sections of doors, approximately 8 by 10 inches (200 by 250 mm), with door faces and edges representing actual materials to be used.
      a. Provide Samples for each species of veneer and solid lumber required.
      b. Provide Samples for each color, texture, and pattern of plastic laminate required.
      c. Finish veneer-faced door Samples with same materials proposed for factory-finished doors.
   2. Louver blade and frame sections, 6 inches (150 mm) long, for each material and finish specified.
   3. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS
   A. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Comply with requirements of referenced standard and manufacturer’s written instructions.
   B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
   C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS
   A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.
   B. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

1.8 WARRANTY
   A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
      1. Failures include, but are not limited to, the following:
         a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
         b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
      2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Algoma Hardwoods
B. VT Industries
C. Ampco, Inc.
D. Products of other manufacturers may be substituted when approved by the Architect.
E. Source Limitations: Obtain flush wood doors from a single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."

B. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.

D. WDMA I.S.1-A Performance Grade:
   1. Heavy Duty unless otherwise indicated.
   2. Extra Heavy Duty: Classrooms, public toilets, janitor's closets, assembly spaces, exits, and patient rooms.

E. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
   1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
   2. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
      a. Finish steel edges and astragals with baked enamel same color as doors.
      b. Finish steel edges and astragals to match door hardware (locksets or exit devices).
F. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.

G. Particleboard-Core Doors:
   2. Blocking: Provide wood blocking in particleboard-core doors as follows:
      a. 5-inch top-rail blocking, in doors indicated to have closers.
      b. 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
   3. Provide doors with structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

H. Structural-Composite-Lumber-Core Doors:
      a. Screw Withdrawal, Face: 700 lbf.
      b. Screw Withdrawal, Edge: 400 lbf.

I. Mineral-Core Doors:
   1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
   2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as follows:
      a. 5-inch top-rail blocking.
      b. 5-inch bottom-rail blocking, in doors indicated to have protection plates.
      c. 5-inch midrail blocking, in doors indicated to have armor plates.
      d. 4-1/2-by-10-inch lock blocks 5-inch midrail blocking, in doors indicated to have exit devices.
   3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:
   1. Grade: Premium, with Grade AA faces.
   2. Species: White oak.
   5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
   6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet or more.
8. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
10. Exposed Vertical and Top Edges: Same species as faces or a compatible species - edge Type A.
12. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
13. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

2.4 PLASTIC-LAMINATE-FACED DOORS

A. Interior Solid-Core Doors:
   1. Grade: Premium.
   2. Plastic-Laminate Faces: High-pressure decorative laminates complying with NEMA LD 3, Grade HGS.
   3. Colors, Patterns, and Finishes: As selected by Architect from laminate manufacturer's full range of products.
   5. Core: Particleboard.
   6. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before faces and crossbands are applied. Faces are bonded to core using a hot press.
   7. WDMA I.S.1-A Performance Grade: Extra Heavy Duty or Heavy Duty.

2.5 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
   1. Wood Species: Same species as door faces.
   2. Profile: Flush rectangular beads.
   3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

C. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch-thick, cold-rolled steel sheet; factory primed for paint finish; and approved for use in doors of fire-protection rating indicated.

D. Wood Louvers: Door manufacturer's standard solid-wood louvers unless otherwise indicated.
   1. Wood Species: Same species as door faces.
E. **Metal Louvers:**

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   
   a. Air Louvers Inc.; a Division of the Activar Construction Products Group.
   b. Anemostat Products; a Mestek company.
   c. L & L Louvers, Inc.
   d. Louvers & Dampers, Inc.; a division of Mestek, Inc.

2. **Blade Type:** Vision-proof, inverted V.
3. **Metal and Finish:** Hot-dip galvanized steel, 0.040 inch thick, factory primed for paint finish.

F. **Louvers for Fire-Rated Doors:** Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire-protection rating of 1-1/2 hours and less.

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   
   a. Air Louvers Inc.; a Division of the Activar Construction Products Group.
   b. Anemostat Products; a Mestek company.
   c. L & L Louvers, Inc.
   d. Louvers & Dampers, Inc.; a division of Mestek, Inc.

2. **Metal and Finish:** Hot-dip galvanized steel, 0.040 inch thick, factory primed for paint finish.

2.6 **FABRICATION**

A. **Factory fit doors to suit frame-opening sizes indicated.** Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. **Comply with NFPA 80 requirements for fire-rated doors.**

B. **Factory machine doors for hardware that is not surface applied.** Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. **Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.**
2. **Metal Astragals:** Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. **Transom and Side Panels:** Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

1. **Fabricate door and transom panels with full-width, solid-lumber, rabbeted, meeting rails.** Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.

D. **Openings:** Factory cut and trim openings through doors.
1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 00 “Glazing.”

2.7 SHOP PRIMING

A. Doors for Transparent Finish: Shop prime faces and all four edges with stain (if required), other required pretreatments, and first coat of finish as specified in Section 09 93 00 “Staining and Transparent Finishing.” Seal edges of cutouts and mortises with first coat of finish.

2.8 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Factory finish doors that are indicated to receive transparent finish.

D. Factory finish doors where indicated in schedules or on Drawings as factory finished.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 08 71 00 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.
C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 14 16
SECTION 08 33 00 – COILING FIRE AND SMOKE RATED DOORS

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Provide all materials, labor, equipment and services necessary to furnish, deliver and install all work under this section as shown on the contract documents, specified herein, and as specified by the job conditions.

1.02 DESCRIPTION

A. Related work specified elsewhere:
   1. Metal Fabrication. Section 05 50 00
   2. Rough Carpentry. Section 06 10 00
   4. Painting: Section 09 90 00
   5. Electrical: Division 26

1.03 SUBMITTALS

A. Procedures: Furnish submittals in accordance with the general requirements specified.

B. Shop Drawing: Furnish shop drawings for architect's approval. Include elevations, sections, and details indicating dimensions, materials, finishes, conditions for anchorage and support of each door.

C. Certifications:
   1. Submit manufacturer's Underwriters Laboratories (UL), Warnock Hersey (WH) or Factory Mutual Research (FM) laboratory test report verifying product compliance in accordance with the required fire and smoke ratings.
   2. Provide manufacturer's ICC Evaluation Service report confirming compliance of the fire door assembly in accordance with the requirements of the Building Code.

D. Product Literature: Submit manufacturer's technical literature describing the product to be used under this section.

E. Maintenance and Operating Manuals: Furnish complete manuals describing the materials, devices and procedures to be followed in operating and maintaining all doors under this section. Include manufacturer's brochures and parts lists describing the actual materials used in the product.

1.04 QUALITY ASSURANCE

A. Fire & Smoke Rated Assemblies: Provide all doors with fire and smoke resistance rating required to comply with governing regulations which are inspected, tested, listed and labeled by UL, WH or FM and complying with NFPA 80 for class of opening. Provide units tested in accordance with the requirements of UL 10B, UL 1784, NFPA 252, ASTM E-152. Provide testing laboratory label permanently fastened to each fire and smoke door assembly.

B. Regulatory Requirements:
   1. Comply with applicable requirements of the laws, codes, ordinances and regulations of federal, state and municipal authorities having jurisdiction.
   2. Listed by the ICC Evaluation Service in accordance with the applicable sections of the Building Code.
C. Testing: Provide documentation from a certified testing agency that the fire door’s self-closing governor mechanism and fire door operator have been tested for a minimum of 50,000 cycles and 500 self closing trip tests.

D. Manufacturer Requirements: Door manufacturer shall have been in the business of and have experience in manufacturing the type of product covered under this specification section as well as giving credible service for a minimum of five (5) years. Provide list of at least ten (10) completed projects which include the products covered under this section.

1.05 DELIVERY, STORAGE AND HANDLING

A. General: Deliver and store materials in manufacturer's original packaging, labeled to show name, brand and type. Store materials in a protected dry location off the ground in accordance with manufacturer's instructions.

1.06 WARRANTY

A. Door Warranty: Furnish one (1) year written warranty signed by the manufacturer and installer agreeing to repair or replace work which has failed as a result of defects in materials or workmanship. Upon notification within the warranty period, such defects shall be repaired at no cost to the owner.

PART 2 PRODUCTS

2.01 COILING FIRE & SMOKE RATED DOORS

A. Manufacturer: Coiling fire and smoke rated doors shall be the Auto-Set System model FSFD-M-G as manufactured by McKeon Door Company.
B. Cookson Model M100
C. Cornell Alarm Guard
D. Overhead Door M system

2.02 MATERIALS

A. Curtain: Shall be assembled of interlocking galvanized steel slats, cold rolled. Slats shall have endlocks locking each end of alternate slats to act as a wearing surface, and maintain slat alignment. Curtain shall be 22 gauge minimum or gauge required by UL, WH or FM which ever is greater.
   1. Slats: Shall be of a cross section not less than 3" wide by 7/8" deep.

B. Bottom Bar: Shall consist of two (2) angles, each not less than 2" x 2" x 1/8" steel formed to fit slats.

C. Guides: Each guide assembly shall be fabricated of a minimum 3" x 3" steel support angle or tube, a 2" x 3" inner guide angle and a 3" x 3" outer guide angle. Support tubes shall be constructed with a slip joint at the top to provide for thermal expansion and guide angles shall be provided with slotted holes to allow for thermal expansion.
   1. Provide internal, fully concealed UL Classified smoke seals located within each guide assembly. Externally mounted smoke seals shall not be acceptable.

D. Mounting Brackets: Fabricated of hot rolled 3/16" steel plate minimum, brackets shall be provided to house ends of the counterbalance barrel assembly.
E. Support: Provide steel support tubes and miscellaneous steel fabrications as required meeting the requirements of 05 50 00 Metal Fabrications as required for support of coiling door at sides/top of opening.

F. Hood: Shall be provided to entirely enclose curtain and counterbalance barrel assembly. Hood shall be fabricated 22 gauge galvanized steel and designed to match brackets. Top and bottom shall be bent and reinforced for stiffness.
   1. Provide UL Classified lintel smoke seals.

G. Counterbalance Assembly: Fire door shall be counterbalanced by means of adjustable steel helical torsion springs attached to shaft enclosed in pipe with required mounting blocks or rings for attachment of curtain. Grease sealed bearings or self-lubricating graphite bearings shall be attached to the spring barrel which shall be fabricated of hot formed structural quality carbon steel seamless pipe.

H. Electric Motor Operator: Fire door shall be provided with a compact power unit designed and built by the door manufacturer. Operator shall be equipped with an adjustable screw-type limit switch to break the circuit at termination of travel. High efficiency planetary gearing running in an oil bath, shall be furnished together with a centrifugal governor, magnetic operated brake and a fail-safe magnetic release device, completely housed to protect against damage, dust and moisture. An efficient overload protection device, which will break the power circuit and protect against damage to the motor windings shall be integral with the unit. Operator is to be housed in a NEMA type 1 enclosure.
   1. Motor: Shall be intermediate duty, thermally protected, ball bearing type with a class A or better insulation. Horsepower of motor is to be 1/3hp minimum or of manufacturer's recommended size, which ever is greater.
   2. Starter: Shall be size "0" magnetic reversing starter, across the line type with mechanical and electrical interlocks, with 10 amp continuous rating and 24 volt control circuit.
   3. Reducer: Planetary gear type, 80% efficiency minimum.
   4. Brake: Magnetically activated, integral within the operator's housing.
   5. Control Station: Provide flush mount key switch control station marked open, close and stop.

I. Self-Closing Mechanism: The fire door is to be designed with a centrifugal governor as an integral part of the operator's construction. The automatic release mechanism shall be activated by a fusible link, smoke detector or fire alarm. When activated the door is released and begins to close due to gravitational force. The speed of the door is governed by a centrifugal governor, designed to match the normal operating speed of the door, at a rate of not greater than 9" per second or less than 6" per second.

J. Magnetic Release with 10 Second Time Delay: A fail-safe magnetic release device shall be built into the operator as an integral part of the release mechanism. When power is interrupted to the release mechanism by the smoke detector or fire alarm, the door shall begin to self-close. In the event of power failure the time delay shall prevent the fire door from closing for a period of 10 seconds. Once the 10 seconds have lapsed, the fire door shall self-close. Once power has been restored to the release mechanism the automatic reset time delay as well as the fire door shall automatically reset themselves.

K. Obstruction Sensing Safety Edge: The fire door shall be designed with an obstruction sensing safety edge. Wireless Type. In the event that the safety edge meets an obstruction during the normal closing operation, the door shall stop, reverse and return to the open position. In the event the safety edge meets an obstruction during the self-closing operation, the door shall come to rest on the obstruction and once the obstruction has been removed the fire door shall continue to the fully closed position.

L. Easy Trip Test Feature: The fire door shall be designed so that it may be trip tested simply by cutting power to the operator. By turning the power switch off, the door shall self-close. Once the fire door has satisfactorily
closed, it shall be reset simply by turning the power back on. No ladders or tools shall be needed to reset the door or the time delay unit.

M. Finish: After completion of fabrication, clean all metal surfaces to remove dirt and chemically treat to provide for paint adhesion. Curtain assembly is to receive a prime coat finish of .2 mils of epoxy primer and .8 mils of polyester paint in a standard Gray finish

PART 3 EXECUTION

3.01 EXAMINATION
   A. Examine surfaces and field conditions to which this work is to be performed and notify architect if conditions of surfaces exist which are detrimental to proper installation and timely completion of work.
   B. Verify all dimensions taken at job site affecting the work. Notify the architect in any instance where dimensions vary.
   C. Coordinate and schedule work under this section with work of other sections so as not to delay job progress.

3.02 INSTALLATION
   A. Perform installation using only factory approved and certified representatives of the door manufacturer.
   B. Install door assemblies at locations shown in perfect alignment and elevation, plumb, level, straight and true.
   C. Adjust door installation to provide uniform clearances and smooth non-binding operation.
   D. Install wiring in accordance with applicable local codes and the National Electrical Code Standard. Materials shall be UL listed.
   E. Test door closing sequence when activated by the building's fire alarm system. Reset door after successful test.

3.03 PROTECTION AND CLEANING
   A. Protect installed work using adequate and suitable means during and after installation until accepted by owner.
   B. Remove, repair or replace materials which have been damaged in any way.
   C. Clean surfaces of grime and dirt using acceptable and recommended means and methods.

END SECTION 08 33 00
SECTION 08 38 00 TRAFFIC DOORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Medium to Heavy impact traffic doors.
B. Hardware and accessories.

1.2 RELATED SECTIONS

A. Section 06 01 14 - Wood Blocking and Curbing: Rough wood framing for door opening.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 30 00.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Operation and maintenance data.
C. Shop Drawings: Show fabrication and installation details; include door elevations, head, jamb, and meeting stile details including full or partial gaskets.
D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.
E. Manufacturer's warranties.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation. Do not lay flat.

1.5 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.6 WARRANTY
A. Provide manufacturer's standard two-year warranty that products are free of defects in material and workmanship and guaranteeing to replace (exclusive of freight and labor) parts proven defective within two years after date of shipment to purchaser.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Eliason Corp., 9229 Shaver Rd.; Kalamazoo, MI 49024; Toll Free Tel: 800-828-3655; Tel: 269-327-7003; Fax: 800-828-3577; Email: doors@eliasoncorp.com Website: www.eliasoncorp.com.

B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.2 TRAFFIC DOORS, HARDWARE AND ACCESSORIES

A. Light to Medium Duty Doors: 3/4 inch (19 mm) exterior grade solid wood core; 1 inch (25 mm) total thickness; light to medium duty. Easy swing hardware. (Model SCP-3).
   1. Facing: Full length stainless steel panels.
      a. Full Length Panels: 20 gauge (0.91 mm) stainless steel both sides; stainless steel top hinge covers. (Model SCP-3)
   2. Window Size: 9 inches (229 mm) wide by 14 inches (356 mm) high.

B. Hinges: Double Action Easy Swing or V-cam hinges.
   1. Finish: zinc plated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Verify jambs are plumb and square.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Anchor assembly to wall construction and building framing without distortion or stress.
C. Fit and align door assembly including hardware.
D. Minimum jamb construction of double stud 2 by 4 wood construction or equivalent.
E. Reinforce hollow metal jambs at hardware locations.
F. Steel channel jambs are required for heavy duty traffic doors.
G. Adjust door assembly to smooth operation and in full contact with weatherstripping.

3.4 CLEANING
A. Clean doors, frames and glass.
B. Remove temporary labels and visible markings.

3.5 PROTECTION
A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 08 38 00
SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Interior storefront framing.
   2. Aluminum framed display case, Room 101A.

B. Related Requirements:
   1. Section 062023 “Interior Finish Carpentry” for option of wood infill panels.
   2. Section 088000 “Glazing” for option of opaque glass infill panels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Sustainable Design Submittals:
   1. Product Data: For sealants, indicating VOC content.
   2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
   3. Product Data: For sealants, indicating VOC content.

C. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
   1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
   2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

F. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:
   1. Joinery, including concealed welds.
   2. Anchorage.
   5. Flashing and drainage.

G. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.5 INFORMATIONAL SUBMITTALS

A. Preconstruction Laboratory Mockup Testing Submittals:
   1. Testing Program: Developed specifically for Project.
   2. Test Reports: Prepared by a qualified preconstruction testing agency for each mockup test.
   3. Record Drawings: As-built drawings of preconstruction laboratory mockups showing changes made during preconstruction laboratory mockup testing.

B. Qualification Data: For Installer.

C. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
   1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.

D. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.

E. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality-control reports.

F. Source quality-control reports.
G. Field quality-control reports.

H. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality-control program.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

C. Structural-Sealant Glazing: Comply with ASTM C 1401 for design and installation of storefront systems.

1.8 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 WARRANTY

A. Special Warranty: Manufacturer / Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.
e. Failure of operating components.

2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: Insert number years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances, storefronts, and aluminum-framed display cases.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances, storefronts, and display cases shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.

2. Failure also includes the following:
   a. Thermal stresses transferring to building structure.
   b. Glass breakage.
   c. Noise or vibration created by wind and thermal and structural movements.
   d. Loosening or weakening of fasteners, attachments, and other components.
   e. Failure of operating units.

C. Structural Loads:

   1. Wind Loads: As indicated on Drawings.
   2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:

   1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
   a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
   a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans less than 11 feet 8-1/4 inches (3.6 m).

E. Structural: Test according to ASTM E 330 as follows:
   1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
   2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
   3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
   1. Fixed Framing and Glass Area:
      a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. EFCO Corporation
   2. Kawneer North America; an Alcoa company
   3. Tubelite Inc

B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
   2. Glazing System: Retained mechanically with gaskets on four sides.
   5. Fabrication Method: Field-fabricated stick system.
B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:
   1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
      c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
      d. Structural Profiles: ASTM B 308/B 308M.
   2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
      a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
      b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
      c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
   1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
   2. Door Design: As indicated Wide stile; 5-inch (127-mm) nominal width.
      a. Provide nonremovable glazing stops on outside of door.

2.5 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule and entrance door hardware sets indicated in "Entrance Door Hardware Sets" Article for each entrance door to comply with requirements in this Section.
   1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

3. Opening-Force Requirements:
   a. Egress Doors: Not more than 15 lb (67 N) to release the latch and not more than 30 lb (133 N) to set the door in motion.
   b. Accessible Interior Doors: Not more than 5 lb (22.2 N) to fully open door.

C. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
   1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
   2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

D. Pivot Hinges: BHMA A156.4, Grade 1.
   1. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.

E. Butt Hinges: BHMA A156.1, Grade 1, radius corner.
   1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
   2. Exterior Hinges: Stainless steel, with stainless-steel pin.
   3. Quantities:
      a. For doors up to 87 inches (2210 mm) high, provide three hinges per leaf.
      b. For doors more than 87 and up to 120 inches (2210 and up to 3048 mm) high, provide four hinges per leaf.

F. Continuous-Gear Hinges: Manufacturer's standard with stainless-steel bearings between knuckles, fabricated to full height of door and frame.

G. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.


J. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

K. Cylinders: As specified in Section 087100 "Door Hardware."
   1. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE".
L. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

M. Operating Trim: BHMA A156.6.

N. Removable Mullions: BHMA A156.3, extruded aluminum.

1. When used with panic exit devices, provide removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.

O. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.

P. Concealed Overhead Holders: BHMA A156.8, Grade 1.

Q. Surface-Mounted Holders: BHMA A156.16, Grade 1.

R. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

S. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

T. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

U. Silencers: BHMA A156.16, Grade 1.

V. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (12.7 mm).

W. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.6 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

1. Sealant shall have a VOC content of 250 g/L or less.
2. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of
Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.

D. Structural Glazing Sealants: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in storefront system indicated.

1. Color: As selected by Architect from manufacturer's full range of colors.

E. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.


2.7 ALUMINUM-FRAMED DISPLAY CASES

A. Basis-of-Design Product: Subject to compliance with requirements, provide Blumcraft by C.R. Laurence; Series 1301 SM Display Case Door with Sidelights or other manufacturer’s products approved in advance by Architect.

B. Source Limitations: Obtain all components of aluminum-framed display cases and accessories, from single manufacturer.

C. Type: System of extruded aluminum horizontal top and bottom rails for display case door and sidelights as shown on Drawings. Provide surface mounted pivots at top and bottom. Provide lever type cam lock for display case door. Provide roller/catch stop for display case door.

D. Member Sizes: 1-1/4 by 1-1/4 inches.

E. Glazing: Thickness to be confirmed by manufacturer based on size of display case shown on Drawings. Refer to Section 08 80 00 – Glazing for type of glass.

F. Finish: Provide finish to match new aluminum-framed storefronts.

2.8 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

C. Concealed Flashing: Manufacturer’s standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.9 FABRICATION

A. Prior to fabrication and submittal of shop drawings, field verify dimensions and site requirements for door, window and display case openings.

B. Form or extrude aluminum shapes before finishing.

C. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

D. Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Physical and thermal isolation of glazing from framing members.
   4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   5. Provisions for field replacement of glazing from interior.
   6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

E. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

F. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.

G. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
   1. At exterior doors, provide compression weather stripping at fixed stops.
   2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

H. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
   1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
   2. At exterior doors, provide weather sweeps applied to door bottoms.

I. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
J. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.11 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Section 088000 "Glazing."

G. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
   1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
   2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
   1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
   2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
   3. Alignment:
      a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
      b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
      c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
   4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

END OF SECTION 08 41 13
SECTION 08 52 13 – CLAD WINDOWS & DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section includes aluminum-clad wood windows.
   B. Section includes aluminum-clad wood commercial doors.

1.3 PREINSTALLATION MEETINGS
   A. Preinstallation Conference: Conduct conference at Project site
      1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
      2. Review, discuss, and coordinate the interrelationship of wood windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
      3. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
      4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product.
      1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for wood windows.
      2. Include plans, elevations, sections, hardware, accessories, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
   B. Samples: For each exposed product and for each color specified, 2 by 4 inches (50 by 100 mm) in size.
   C. Samples for Initial Selection: For units with factory-applied finishes.
      1. Include Samples of hardware and accessories involving color selection.
D. Samples for Verification: For wood windows and components required, prepared on Samples of size indicated below:

1. Exposed Finishes: 2 by 4 inches (50 by 100 mm).
2. Exposed Hardware: Full-size units.
3. Submit corner section under provision of section 01 33 23
4. Include glazing system, quality of construction and specified finish

E. Product Schedule:
1. For clad wood windows. Use same designations indicated on Drawings.
2. For clad wood doors. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
B. Product Test Reports: For each type of clad wood window and door, for tests performed by a qualified testing agency.
C. Field quality-control reports.
D. Sample Warranties: For manufacturer's warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An installer acceptable to wood window and door manufacturer for installation of units required for this Project.
B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace wood windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Structural failures including excessive deflection, water leakage, and air infiltration.
c. Faulty operation of movable sash and hardware.
d. Deterioration of materials and finishes beyond normal weathering.
e. Failure of insulating glass.
2. Warranty Period:
   a. Window: 10 years from date of Substantial Completion.
   b. Glazing Units: 10 years from date of Substantial Completion.
   c. Aluminum-Cladding Finish: 20 years from date of Substantial Completion.
   d. Factory Applied Interior Finish: 5 years from date of Substantial Completion.
   e. Hardware and other Non-glass Components: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Source Limitations: Obtain clad wood windows and doors from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS
   A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
      1. Window Certification: WDMA certified with label or test report and license number.
   B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
      1. Minimum Performance Class: LC.
      2. Minimum Performance Grade: 50.
   C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.33 Btu/sq. ft. x h x deg F (1.874 W/sq. m x K).
   D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40.
   E. All windows and doors shall be custom sizes indicated in drawings and verified in field to fit existing masonry openings.

2.3 WOOD WINDOWS
   A. Aluminum-Clad Wood Windows:
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         a. EAGLE Window & Door, Inc.; a subsidiary of Andersen Corporation.
         b. Marvin Windows and Doors.
         c. Sierra Pacific Windows; Sierra Pacific Industries.
   B. Operating Types: Provide the following operating types in locations indicated on Drawings:
      1. Double hung.
2. Fixed.

C. Frames and Sashes: Fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide; water-repellent preservative treated.

   a. Aluminum Finish: Manufacturer’s standard fluoropolymer two-coat system with fluoropolymer color topcoat containing not less than 70 percent PF resin by weight and complying with AAMA 2605.
   b. Color: As selected by Architect from manufacturer’s full range.

2. Interior Finish: Manufacturer’s standard factory-prime coat.
   a. Color: As selected by Architect from manufacturer’s full range.

D. Glass: Clear annealed glass, ASTM C 1036, Type 1, Class 1, q3.

1. Kind: Fully tempered where indicated on Drawings and at all locations in walls surrounding exit stairs.

E. Insulating-Glass Units: ASTM E 2190.

1. Glass: ASTM C 1036, Type 1, Class 1, q3.
   a. Tint: Clear.
   b. Kind: Fully tempered where indicated on Drawings.

2. Lites: As indicated on Drawings.

3. Filling: Fill space between glass lites with air or argon gas.

4. Low-E Coating: Sputter-Coated on second surface.

F. Glazing System: Manufacturer’s standard factory-glazing system that produces weathertight seal.

1. Dual Glazing System:
   a. Interior Lite: Glass.
   b. Exterior Lite: Glass.

G. Hardware, General: Provide manufacturer’s standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: Oil Rubbed Bronze.

H. Hung Window Hardware:

1. Counterbalancing Mechanism: Complying with AAMA 902, concealed, of size and capacity to hold sash stationary at any open position.
2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only. **Provide custodial locks.**

3. Tilt Hardware: Releasing tilt latch allows sash to pivot about horizontal axis to facilitate cleaning exterior surfaces from the interior. **Alternatively, window may have mechanism for removal of sash for same purposes.**

I. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

J. Jamb Liner: Provide painted aluminum at exterior - color matches exterior clad aluminum color. Provide paint grade wood at interior, to match interior wood species and color.

K. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ACCESSORIES

A. Dividers (False Muntins): Provide divider grilles in designs indicated for each sash lite.

1. Quantity and Type: **Three per sash, two permanently located at exterior and interior lites and one permanently located between insulating-glass lites.**

2. Material:
   b. Interior: *Ponderosa Pine or Douglas Fir, primed for field painting*
   c. Between Glass: Include between-lite spacer bar

3. Pattern: **As indicated on Drawings.**

4. Profile: **As indicated on Drawings.**

5. Color: Exterior matches exterior aluminum clad colors

6. Color (interior): **Factory applied acrylic latex primer**

B. Aluminum Extrusions:

   a. Profiles: Brick Mould Casing, Flat Casing, Mullion Cover, Custom Profiles as indicated on drawings.

   b. Finish: **Fluoropolymer modified acrylic topcoat applied over primer. Meets AAMA 2605 requirements.**

   c. Color: Matches panel finish with matching screws

2.5 DOOR PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
1. Door Certification: WDMA certified with label or test report and license number.

B. Performance Class and Grade of double outswing doors: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
   1. Minimum Performance Class: LC.

C. Thermal Transmittance: NFRC 100 maximum U-factor of $0.31 \text{ Btu/sq. ft. x h x deg F}$ (1.760 W/sq. m x K).

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum SHGC of 0.40.

E. All glazing in doors, sidelights and transoms shall be tempered.

2.6 CLAD COMMERCIAL DOORS

A. General: Use only materials that comply with referenced standards and other requirements specified.

   1. Assemble exterior doors and sidelites, including components, with wet-use adhesives complying with ASTM D 5572 for finger joints and with ASTM D 5751 for joints other than finger joints.

B. Panel Products: Any of the following unless otherwise indicated:

   1. 1 ¾" Doors: Stiles contain laminated veneer lumber (LVL) core with non finger-jointed Pine, Solid wood top, bottom and intermediate rails.
      a. Kiln dried to moisture content no greater than twelve (12) percent at time of fabrication.
      b. Water repellent, preservative treated in accordance with WDMA I.S.4
      c. This door thickness may be used only where doors are fixed shut at contractor’s option (116B, 121B, 142B, and 161B) but only if appearance matches sufficiently in opinion of architect from manufacturer’s corner sample.

   2. 2 ¼" Doors: Stiles and top rail contain laminated veneer lumber (LVL) core with non finger-jointed Pine. Solid wood bottom and intermediate rails.

   3. Composite panel thickness: 1 ¾" at fixed “closed” doors indicated on drawings, 2 ¼" at operable doors indicated on drawings. Panel configuration shall match historic door design indicated in drawings.

   4. Exterior extruded aluminum clad 0.055" (1.4mm) thick.

   5. Panel corners glued and fastened with 5/8" x 4" (16mm x 102mm) fluted hardwood dowels. Removable interior vinyl glazing stops with non finger-jointed wood covers. 1 ¾" panel: no visible fastener holes; 2 ¼" panel: visible nail fastener on glazing stop.

C. Finish:

   1. Exterior: Aluminum clad. Fluoropolymer modified acrylic topcoat applied over primer. Meets AAMA 2605 requirements. Color as selected by Architect from manufacturer’s full range

   2. Interior wood: Factory applied acrylic latex primer

D. Weather Strip:
1. Head jamb and hinge jamb: bulb type weather strip.
   a. Color: As selected by Architect from manufacturer's full range
2. Locking jamb: Gray pile weather strip
3. Surface mounted aluminum panel drip mounted at bottom of panel (shipped loose for field application)
4. Color: Matches panel finish with matching screws

E. Accessories and Trim:
1. Aluminum Extrusions:
   d. Profile: Brick Mould Casing; Flat Casing; Mullion Cover; Custom Profiles as indicated on drawings.
   e. Finish: Fluoropolymer modified acrylic topcoat applied over primer. Meets AAMA 2605 requirements.
   f. Color: Matches panel finish with matching screws
   g. Brick Mould Casings shall be factory applied.

2. Hardware:
   a. Hardware Finish Oil Rubbed Bronze
   b. ADA compliant door sill and bottom rail
   c. BB NRP hinges, commercial grade, 4 per leaf, wide throw
   d. General contractor to coordinate preparation and installation of door hardware specified under Door Hardware 08 71 00.

2.7 FABRICATION
A. Fabricate wood windows and doors in sizes indicated. Include complete systems for installing and anchoring windows and doors.

B. Glaze wood windows in the factory. Provide protective films to protect glazing during construction.

C. Weather strip each operable sash to provide weathertight installation.

D. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site. Brick mould casing shall be installed in the factory where provided.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer’s written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer’s written instructions, comply with installation requirements in ASTM E 2112.

B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.

   1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 08 52 13
SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Installation of all electrified and mechanical finish hardware items is described and required to be provided in other related Sections of these Specifications.

C. Installation of all access control items and systems is described and required to be provided in this Section of these Specifications.

Hardware supplier must be an authorized, direct factory distributor of all finish hardware and access control products specified herein to insure compliance and service of these products.

D. Unless otherwise approved by the Architect/Engineer, furnish all door hardware items as described in the door hardware schedule.

1.02 SUMMARY

A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.

B. Scope of work includes typical latchset/lockset door hardware and related hinges, door stops, etc., as well as coordination of all door hardware and required frame and door preparation requirements with the same type requirements for electrified hardware items; as indicated in the Door Hardware Sets.

C. This Section includes the following:

1. Butt Hinges
2. Continuous Geared Hinges
3. Cylinders and Keys
4. Mortise Latchsets and Locksets
5. Exit Devices
6. Door Closers
7. Overhead Door Holders / Stops
8. Manual Flush Bolts
9. Automatic Flush Bolts
10. Wall and Floor Stops
11. Door Coordinators
12. Push and Pull Bars
13. Door Pulls
14. Push Plates
15. Electromagnetic Door Releases
16. Mop and Kick Plates
17. Saddle Thresholds
18. Door Sweeps
19. Self-Adhesive Gasketing
20. Perimeter Seals
21. Meeting Stile Seals
22. Mullion Seals
23. Drip Strips
24. Fire Department Key Box
25. Door Silencers

1.03 REFERENCES

A. Standards of the following as referenced:

1. 2010 ADA Standards for Accessible Design
2. American National Standards Institute, Inc. (ANSI)
3. Door and Hardware Institute (DHI)
6. Intertek Testing Services - Warnock Hersey (ITS-WH)
10. Underwriter's Laboratories, Inc. (UL)

B. Regulatory standards of the following as referenced:

1. Department of Justice, Office of the Attorney General, Americans with Disabilities Act, Public Law 101-336 (ADA)

1.04 SYSTEM DESCRIPTION

A. Refer to applicable headings for system description for electric hardware products.

1.05 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification, Section 01 33 00 - Submittal Procedures; for submittal procedures.

B. Product data including manufacturers’ technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.

C. Final hardware / access control systems schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into vertical format “hardware sets” indicating complete designations of every item required for each door or opening. Use specification Set Numbers with any variations suffixed with A, B, etc.. Include the following information:

a. Type, style, function, size, and finish of each hardware item.
b. Name and manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of each hardware set cross referenced to indications on drawings both on floor plans and in door and frame schedule.

e. Explanation of all abbreviations, symbols, and codes contained in schedule.

f. Mounting locations for hardware.

g. Door and frame sizes and materials.

h. Keying information.

i. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

j. Wiring Diagrams: Riser and door elevation; point-to-point diagrams.

k. Cross reference numbers used within schedule deviating from those specified.

(1) Column 1: State specified item and manufacturer.

(2) Column 2: State prior approved substituted item and its manufacturer.

2. Submittal Sequence: Submit schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work (e.g.: hollow metal frames) which is critical in the Project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by door hardware, and other information essential to the coordinated review of hardware schedule.

3. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner’s final instructions on keying of locks has been fulfilled.

D. Samples of each type of exposed hardware unit in finish indicated and tagged with full description for coordination with schedule. Submit samples prior to submission of final hardware schedule.

1. Samples will be returned to the supplier. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated in the work, within limitations of keying coordination requirements.

E. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements. This is a requirement of the door hardware supplier to furnish all templates of each required door hardware item to the suppliers of the hollow metal doors and frames. No templates shall be sent until all door hardware items have been approved.

F. Electronic Hardware Systems:

1. Wiring Diagrams: Coordinate the installation of all required electronic hardware items with the Project Electrical Engineer and furnish all necessary installation and technical data, including wiring diagram drawings, to the Project Electrical Engineer and Electrical Sub-Contractor. Furnish a copy of all wiring diagram drawings with each door hardware schedule submitted after approval.

2. Furnish complete operational descriptions of electronic components listed by each door opening in the door hardware submittals. Operational descriptions are to detail how each electrical component functions within the door opening, incorporating all conditions of ingress and egress. Furnish this information with each door hardware schedule submitted for approval.
3. Furnish elevation drawings of electronic hardware items and systems identifying locations of the system’s components with respect to their placement in the door opening. Furnish a copy of all elevation drawings with each door hardware schedule submitted for approval.

4. Upon completion of the electrical hardware installation, the door hardware supplier shall verify that all electrical components are functioning properly and state in the required guarantee that this inspection has been performed.

G. Contract closeout submittals: At the completion of this Project, furnish to the Owner two (2) copies of an Owner’s Operation and Maintenance Manual. This manual shall consist of a labeled, hardcover, three-ring binder with the following technical information.

1. Maintenance instructions for each door hardware item.
2. Manufacturers’ catalog cut-sheets for each of their respective products.
3. Parts list for each of the manufacturers’ respective products.
4. Final “Approved” Door Hardware Schedule.
5. Final “Approved” Keying Schedule.
6. Warranty: Completed and executed warranty forms.

1.06 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain each type of hardware (latch and lock sets, hinges, closers, security equipment, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.

B. Qualifications of Supplier: A recognized architectural door hardware supplier, with warehousing facilities, who has been furnishing hardware and installation in the Project’s vicinity for a period of not less than 5 years. The supplier shall be, or shall employ, a certified Architectural Hardware Consultant (AHC), who is available, at reasonable times during the course of the work, for consultation about the Project’s hardware requirements, to the Owner, Architect, and Contractor. A certified Architectural Hardware Consultant (AHC) shall prepare all hardware and access control schedules. Supplier shall be responsible for proper coordination of all door hardware items and access control items with related sections, to insure compatibility of products.

1. Hardware supplier must be an authorized, direct factory distributor of all products specified herein to insure compliance and service of these products.

2. Require supplier to meet with Owner to finalize keying requirements and to obtain final instructions in writing.

C. Fire-Rated Openings: Furnish door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of the Authorities Having Jurisdiction. Furnish only items, of
door hardware, that are listed and are identical to products tested by UL, ITS-WH, FM, or other
testing and inspecting organization acceptable to the Authorities Having Jurisdiction, for use on
types and sizes of doors indicated, in compliance with the requirements of fire-rated door and door
frame labels.

Project requires door assemblies and components that are compliant with positive pressure and S
Label requirements. Specifications must be cross-referenced and coordinated with door and frame
manufacturers to ensure that total door opening engineering is compatible with UL10C Standard
for Positive Pressure Fire Tests of Door Assemblies.

D. Product Qualifications: Manufacturers names and numbers are used to indicate the standards of
design and quality. Submittals should include a sheet listing grade of item, duty rating (if
applicable) and finish.

E. Substitutions: All substitution requests are required to be submitted prior to the bid date and
complying with the procedures and time frame as outlined in Division 1, General Requirements.
Approval of submitted products is at the discretion of the Architect and his Hardware Consultant.

F. The Contractor, Hardware Distributor, and Installers shall count, coordinate, and store all door
hardware items herein, verifying complete counts of all items scheduled and furnished. The
Manufacturers’ Representatives will inspect the installation of the door hardware items during that
phase of construction. Any deficiencies in installation of all materials included herein shall be
corrected before installation continues.

G. After door hardware installation, the Door Hardware Manufacturer’s Representative shall conduct a
meeting on-site with the Owner’s Representatives to ensure they are familiar with all applications
and systems, as installed. Refer to additional requirements under 3.0 EXECUTION.

H. Pre-Installation Meeting: Prior to door hardware installation, the Contractor / Construction
Manager shall request a hardware installation meeting to be held at the project’s location. This
meeting shall convene no later than one month prior to the hardware’s installation. The types of
hardware this meeting shall include are: locksets, exit devices, and door closers. The
manufacturer’s representatives of the above listed products, in conjunction with the hardware
supplier for this project, shall conduct the installation training. All hardware installers shall be
required to attend this meeting to receive certificate of authorized training.

This meeting shall serve as door openings coordination and review of all shop drawings from
related trades prior to the hardware installation.

The Hardware Supplier shall include any related meeting costs in their proposal.

I. Electrified Hardware And Security Hardware Systems: Prior to ordering the electrified hardware,
the Contractor shall request a coordination meeting. This meeting shall convene prior to or after
the door hardware schedule and the wiring diagrams have been submitted to the Contractor. All
related trades shall be represented at this meeting, which shall also include the Architect, the
Owner’s representative, and the Hardware Supplier. This meeting shall serve as a review and
coordination of all electrified hardware, wiring, connections, location for power supplies, and
remote switches, and door functions. All related trades shall make any required changes, and
resubmit schedules, diagrams, and any other required data, no later than one (1) week following
this meeting.
1.07 PRODUCT HANDLING

A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.

B. Packaging of door hardware is the responsibility of the supplier. As material is received by the hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set numbers to match the set numbers of the approved hardware schedule. Two or more identical sets may be packed in the same container.

C. The door hardware supplier shall deliver all individually packaged hardware items promptly to the place of installation (Shop or Project Site); direct factory shipments are not acceptable unless agreed upon beforehand. Hardware supplier shall coordinate delivery times and schedules with the Contractor.

D. Inventory door hardware jointly with the Contractor, representatives of the hardware supplier, and the hardware installer, until each is satisfied that the count is correct.

1.08 WARRANTY

A. All materials must be warranted against defects in workmanship and materials for a period of one (1) year from date of acceptance of this project, unless otherwise noted. Any evidence of misuse or abuse voids all warranties. These warranties shall be each manufacturer’s standard written warranty.

B. Special Warranties:

1. Butt Hinges: Lifetime.
2. Continuous Gear Hinges: Life Of The Door Opening.
5. Electrified Exit Devices: Two (2) Year Period.
6. Door Closers: Ten (10) Year Period.
7. Saddle Thresholds, Door Sweeps, Self-Adhesive Gasketing, Perimeter Seals, Meeting Stile Seals, Mullion Seals, and Drip Strips: Two (2) Year Period.

C. Any manufacturer whose standard written warranty does not equal or exceed the requirements listed above must provide a letter stating that they will extend their warranty to comply with the requirements of this specification.

D. Refer to Section 01 70 00 - Execution & Closeout Requirements; for additional warranty requirements.

1.09 MAINTENANCE

A. Maintenance Tools and Instructions: The Contractor shall furnish a complete set of specialized tools and maintenance instructions as needed for the Owner’s continued adjustment, maintenance, and removal and replacement of door hardware.

B. Parts Kits: Furnish manufacturers’ standard parts kits for locksets, exit devices, and door closers.
PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. BUTT HINGES

1. Acceptable Manufacturers:
   a. Hager Companies (HAG).
   b. IVES, Division of Allegion PLC.
   c. McKinney Products Company, An ASSA ABLOY Group company (MCK)
   d. Stanley Hardware, A Division of Stanley Security Solutions, Inc.

2. Characteristics:
   a. Tested to be in accordance with ANSI / BHMA A156.1.
   b. Type: Five (5) knuckle, full mortise, concealed anti-friction bearing.
   c. Templates: Furnish only template-produced units.
   d. Fasteners: Furnish Phillips flat-head screws complying with the following requirements.
      (1) For metal doors and frames, install machine screws into drilled and tapped holes.
      (2) For wood doors and frames, install threaded-to-the-head wood screws.
      (3) For fire-rated wood doors, install #12 x 1-1/4 inch, threaded-to-the-head steel wood screws.
      (4) Finish screw heads to match surface of hinges or pivots.
   e. Hinge Pins: Except as otherwise indicated, furnish hinge pins as follows:
      (2) Out-Swing Interior Doors: Non-rising pins and Non-removable pins; as indicated in the Door Hardware Sets.
      (3) In-Swing Exterior / Interior Doors: Non-rising pins.
      (4) Tips: Flat button and matching plug. Finished to match leaves.
   f. Size: Size hinges in accordance with the specified manufacturer's published recommendations.
   g. Quantity: Furnish one pair of hinges for all doors up to 5'-0" high. Furnish one additional hinge for each additional 2-1/2 feet or fraction thereof.

B. CONTINUOUS GEARED HINGES

1. Acceptable Manufacturers:
   a. Hager Companies, ROTON Division
   b. IVES, Division of Allegion PLC.
   c. PEMKO, An ASSA ABLOY Group company (PEM)
   d. Select Products Limited

2. Characteristics:
   a. Tested to be in accordance with ANSI / BHMA A156.26.
   b. Templates: Furnish only template-produced units.
   c. All hinges are to be “Concealed Surface Mount”.
   d. Hinges to be manufactured of extruded 6063-T6 aluminum alloy with an anodized finish.
   e. All hinge profiles to be manufactured to template bearing locations at 2 9/16"
spacing.

f. All hinges are to be furnished factory cut for each door size.

g. Vertical door loads shall be carried on chemically lubricated polyacetal thrust bearings.

h. The door and frame leaves shall be continuously geared together for the entire hinge length and this relationship secured with a full-length cover channel so that the hinge will operate through a full swing of 180 degrees.

i. All rotating areas of the gear cap and geared leaves shall have a permanent lubricant which is factory applied along the full length of the hinge, and the lubricant shall last the life of the hinge without any additional maintenance required.

j. Fasteners: Furnish 410 stainless steel, brite hardened and plated #12-24 x 7/16” Thread-Forming, Phillips Undercut Flathead hinge screws and #12-14 x 1 1/2” Flathead wood screws; as required.

k. Finish: 204R1 Clear (.4-.7 mil) Anodized.

C. CYLINDERS AND KEYS

1. Acceptable Manufacturers:

   Facility’s Standard
   (Substitutions Shall Not Be Acceptable)

2. Characteristics:
   a. Tested to be in accordance with ANSI / BHMA A156.28.
   b. Existing Key System: Furnish all cylinders and locksets keyed into Johnson City School System’s existing key system, for this project.
   c. Equip all cylinders and locksets with, a minimum of, 6-pin interchangeable core, tumbler cylinders.
   d. Furnish cylinders and locksets with temporary, brass / keyed, “Construction” interchangeable cores for the duration of the time of construction. Construction cores, master keys, and control keys shall not be part of the Owner’s permanent key system or furnished on the same keyway (or key section) as the Owner’s permanent key system. Construction cores, master keys, and control keys are the property of the manufacturer and shall be returned when the permanent cores and keys are installed. Remove these “Construction” interchangeable cores Only when directed by the Architect and / or Owner.
   e. Furnish final “Permanent” interchangeable cores and keys, for installation by the Owner.
   f. Metals: Construct lock cylinder parts from brass or bronze, stainless steel, or nickel silver.
   g. Comply with the Owner’s instructions for keying requirements and, except as otherwise indicated, provide individual change keys for each lock that is not designated to be keyed alike with a group of related locks.

   (1) Permanently inscribe each key with number of lock that identifies the cylinder manufacturer’s key symbol (code), and notation, “DO NOT DUPLICATE”.

   (2) Permanently inscribe each core, in a concealed location, with the applicable key mark that identifies the cylinder manufacturer’s key symbol (code).
Key control marks (codes) shall not include the actual key cuts.

h. A keying meeting between the Owner and a representative of the successful door hardware distributor shall be arranged subsequent to the return of the Approved Door Hardware Schedule. A keying schedule will be established by the door hardware distributor’s representative and submitted to the Owner, for approval. After the Owner’s review, the keying schedule shall be returned to the distributor’s representative such that the permanent cores and keys can be prepared on a timely basis.

i. Permanent cores and keys will be transmitted directly to the Owner by the Door Hardware Distributor. The Owner shall be responsible for the installation of the permanent cores and the return of the construction cores and keys.

j. Key Material: Furnish keys of nickel silver only.

k. Key Quantities: Furnish the following quantities of keys for the entire project.

   (1) Ten (10) Each - Construction Master Keys
   (2) Two (2) Each - Construction Control Keys
   (3) Three (3) Each - Permanent Great Grand Master Keys
   (4) Five (5) Each - Permanent Grand Master Keys
   (5) Five (5) Each - Permanent Master Keys (For Each Area)
   (6) Two (2) Each - Permanent Control Keys
   (7) Four (4) Each - Permanent Change Keys

   (For Each Keyed Door Opening)

   Deliver all Construction interchangeable cores and keys to the General Contractor.
   Deliver all Permanent interchangeable cores and keys to the Owner, via Registered Mail.

D. MORTISE LATCHSETS AND LOCKSETS

1. Acceptable Manufacturers:
   b. Schlage Lock Co. LLC: division of Allegion, PLC – L9000 series x 07A/07N Trim.

2. Characteristics:
   a. Conforms to and/or exceeds all ANSI / BHMA A156.13, Series 1000, Grade 1 Operational, Grade 2 Security. ANSI / ASTM F476-84 Grade 30, U.L. Listed. Conform to and/or exceed 800,000 cycle ANSI Grade 1 requirements.
   b. Latchsets and locksets shall have all functions available in a one size case, fabricated from heavy wrought steel, zinc dichromate plated for corrosion resistance and lubricity of internal parts. Cases shall be closed on all sides to protect internal parts.
   c. The handing of all latchsets and locksets shall be reversible without the disassembly of the lockcase.
   d. Latchsets and locksets shall have adjustable, beveled and armored fronts, with standard 2-3/4” (70mm) backsets, with full 3/4” (19mm) throw two or three-piece mechanical stainless steel anti-friction
latchbolts, one-piece stainless steel 1" throw deadbolts, and stainless steel auxiliary bolts.

e. All latchsets and locksets with latchbolts, regardless of trim design, shall be listed by Underwriters Laboratories for 3-hour fire rated and lesser classified doors.

f. Lock trim (knobs, levers, sectional or escutcheon) shall be throughbolted through the lockcase to assure correct alignment and proper operation.

g. Latchsets and locksets shall be furnished with replaceable breakaway spindles, designed to resist excessive force from vandalism, preventing damage to lever trim and internal lock case components.

h. Where indicated in the Door Hardware Sets, when the outside lever handle is locked, the lever shall rotate freely and shall return to its horizontal position when released. The locked outside lever handle shall freely rotate up and down while remaining securely locked.

i. Lever handles shall be one-piece, solid, brass, bronze, or stainless steel.

j. Armor fronts, escutcheons, and roses shall be fabricated from brass, bronze, or stainless steel.

k. Strikes shall be 16 Gauge, curved, brass, bronze or stainless steel, with 1" deep strike boxes, and furnished with lips of sufficient lengths to clear trim and protect clothing.

l. Furnish “Knurled” outside levers; as indicated in the Door Hardware Sets.

“Abrasive” outside levers shall not be acceptable.

E. EXIT DEVICES

1. Acceptable Manufacturers:
   a. Corbin Russwin, Inc., An ASSA ABLOY Group company (C-R) - ED5000 / ED4000 Series.
   b. Von Duprin, Division of Allegion, PLC – 98/35 Series
   c. Sargent Lock Co., an ASSA/ABLOY Group Co. – 80 Series

2. Characteristics:
   a. Tested to be in accordance with ANSI A156.3, 1994, Grade 1. All exit devices to be heavy duty, with one-piece removable covers. The housing shall be manufactured from extruded aluminum without exposed screws or rivets.
   b. Exit Devices shall be “UL” listed for Life Safety. All exit devices for fire-rated door openings shall have “UL” labels for “Fire Exit Hardware”. All exit devices shall conform to NFPA 80 and NFPA 101 requirements.
   c. All series exit devices shall be “touchpad” (modern) types, incorporating a hydraulic fluid damper, which decelerates the touchpad on its return stroke and eliminates noise associated with the exit device operation. All exit devices shall be non-handed. The touchpad shall extend a minimum of 1/2 of the door width and shall be a minimum of 2-1/4” in height.
   d. All latchbolts to be the deadlocking type. Latchbolts shall have a self-lubricating
coating to reduce wear.

Plated or plastic coated latchbolts shall not be acceptable.

e. All flush metal end caps shall be standard with all exit devices.

f. Exit device strikes, where surface applied, shall be a roller type and have an anti-slip mounting plate.

g. All outside exit device trim shall be forged brass, full escutcheon. The lever trim shall be a “Free Wheeling” vandal-resistant design type with a clutch mechanism allowing the lever to rotate 60 degrees when locked, to prevent vandalism.

h. The exit device end caps shall be secured with three (3) screws to a truss bracket.

i. The “touchpad” exit devices shall be patterned punched to designate code requirements; where required.

j. Where detailed, removable mullions shall be 2 inches x 3 inches steel tubes and of a type that can be removed by the use of a key-operated cylinder, which shall be self-locking when re-installed.

k. All exit devices shall be made of brass, bronze, stainless steel, or aluminum material, plated to the standard architectural finishes to match the balance of the door hardware.

Painted or anodized aluminum finishes shall not be acceptable.

F. DOOR CLOSERS

1. Acceptable Manufacturers:
   a. Corbin Russwin, Inc., An ASSA ABLOY Group company (C-R) - DC6000/DC62900 Series.
   b. Sargent Manufacturing, An ASSA/ABLOY group company 281/2478 Series
   c. LCN, Division of Allegion LLC – 4040XP/4040SE-DE series

2. Characteristics:
   a. Door closers shall have fully hydraulic, full rack and pinion action with a high strength cast iron cylinder; which have been tested and certified under ANSI Standard A156.4, Grade 1.
   b. Hydraulic fluid shall be of an all weather type, requiring no seasonal closer adjustment.
   c. Spring power shall be continuously adjustable over the full range of closer sizes, and allowing for reduced opening force for the physically handicapped. Hydraulic regulations shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed and back check.
   d. All closers shall have solid forged steel main arms (and forearms for parallel arm closers) and where specified shall have a spring loaded stop in the soffit shoe; as indicated in the Door Hardware Sets. Where door travel on out-swing doors must be limited, use spring loaded stop in the soffit shoe type closers. Auxiliary stops are not required when spring loaded stop in the soffit shoe type closers are used.
e. Closers shall have non-metallic full, plastic, covers, which provides complete enclosure.
f. All closers shall be certified to exceed Ten Million (10,000,000) full load cycles by a recognized independent testing laboratory. All closers shall be of one manufacturer and shall maintain the manufacturer’s ten (10) year warranty.
g. Access-Free Manual Closers: Where manual closers are indicated for doors required to be accessible to the physically handicapped, furnish adjustable units complying with ADA and ANSI A117.1 provisions for door opening force.
h. Closers shall be attached utilizing through bolts with wood and machine screws.
i. Closers to be installed to allow door swing as shown on plans. Doors swinging into exit corridors shall provide for corridor clear width as required by code. Where possible, mount closers inside rooms.
j. Powder coating finish to be certified to exceed 100 hours salt spray testing by ETL, an independent testing laboratory used by BHMA for ANSI certification.

Lacquer or painted finish on metal components shall not be acceptable.
k. Where indicated in the Door Hardware Sets, door closers shall be furnished with a Special Rust Inhibitor Pre-Treatment.
l. Where indicated in the Door Hardware Sets, furnish door closers with an Adjustable Delayed Action Closing feature, to delay the closing up to one (1) minute from the maximum opening to approximately 75 degrees.

G. DOOR OPERATORS
1. Acceptable Manufacturers:
   a. LCN, A Division of Allegion LLC (LCN)
   b. Norton Door Controls, A Division of ASSA/ABLOY Group
   c. Comparable Products of other manufactures will be accepted, if they are proven to be equal in features and performance of specified products.

2. Characteristics
   a. Tested to be in accordance with ANSI / BHMA A156.19, Grade 1.
   b. Meets all ADA requirements.
   c. Powered operators to be controlled via “wireless” controls.
   d. Designed to operate with indicated door opening sizes.
   e. Design shall provide the least possible appearance from the exterior view.

H. OVERHEAD DOOR HOLDERS / STOPS
1. Acceptable Manufacturers:
   a. Glynn Johnson Door Controls, Division of Allegion LLC - 90 Series.
   b. Rixson Specialty Door Controls, An ASSA ABLOY Group company (RIX) - 9 Series.
   c. ABH Manufacturing, Inc., - 9000 Series

2. Characteristics:
   a. Tested to be in accordance with ANSI / BHMA A156.8, Grade 1.
b. Furnish medium duty and heavy duty door stops, non-handed / reversible, of a, where detailed, carbon steel base substrate material or 300 Series Stainless Steel substrate material.

c. Furnish units with a shock absorbing mechanism for added durability.

d. All units are to be installed with the jamb bracket mounted on the stop, unless as indicated in the Door Hardware Sets, “Angle Jamb Brackets” are specified to be utilized.

Overhead door stops specified with “Angle Jamb Brackets” are used to convert the installation of the units to hinge side mounting.

I. MANUAL FLUSH BOLTS

1. Acceptable Manufacturers:
   a. IVES, Division of Allegion LLC
   b. Burns Manufacturing, Inc.

2. Characteristics:
   a. Tested to be in accordance with ANSI / BHMA A156.16, Grade 1.
   b. Flush bolts shall be 6-3/4” x 1”, made from forged brass, with 1/2” diameter bolts.
   c. Flush bolts shall have a spring loaded snap action lever, which will retract the bolt when moved to the “up” position, and project the bolt into the head frame when moved to the “down” position.
   d. Flush bolts shall have a 3/4” bolt throw and, where detailed, a 12” rod length.
   e. Furnish Dust Proof Strikes, for all flush bolts, with a spring loaded plunger which will return to the floor or threshold anytime the flush bolt is retracted. The Dust Proof Strikes shall be installed in the floors or the thresholds, as indicated in the Door Hardware Sets.

J. AUTOMATIC FLUSH BOLTS

1. Acceptable Manufacturers:
   a. Door Controls International, Inc.
   b. Ives, Division of Allegion LLC.
   c. Rockwood Manufacturing Company, An ASSA ABLOY Group company (ROC)

2. Characteristics:
   a. Tested to be in accordance with ANSI / BHMA A156.3, Type 25.

b. Flush bolts shall be fully automatic. The inactive door is latched when the active door closes, the bolts retract when the active door is opened.

c. Flush bolts shall have a 3/4” bolt throw.

d. Flush Bolts shall be U.L. Listed for installation on fire-labeled door openings.

e. Furnish Dust Proof Strikes, for indicated flush bolts, with a spring loaded plunger which will return to the floor or threshold anytime the flush bolt is retracted. The Dust Proof Strikes shall be installed in the floors or the thresholds, as indicated in the Door Hardware Sets.

K. WALL AND FLOOR STOPS

1. Acceptable Manufacturers:
   a. IVES, Division of Allegion LLC.
b. Burns Manufacturing, Inc.
c. Rockwood Manufacturing Company, An ASSA ABLOY Group company (ROC)

2. Characteristics:
   a. Tested to be in accordance with ANSI / BHMA A156.16, Grade 1.
   b. Wall Bumpers shall have a solid forged brass housing with a concealed, in the convex bumper, attachment. Furnish with wood screw and plastic anchors.
   c. Floor Stops shall be made from solid cast brass or bronze. Furnish with machine screws and lead expansion shield anchors.
   d. Install floor stops in such a position that they permit maximum door swing, but do not present a hazard or obstruction.

L. DOOR COORDINATORS

1. Acceptable Manufacturers:
   a. IVES, Division of Allegion LLC.
   b. Burns Manufacturing, Inc.
   c. Rockwood Manufacturing Company, An ASSA ABLOY Group company (ROC)

2. Characteristics:
   a. Tested to be in accordance with ANSI / BHMA A156.3, Type 21.
   b. Door Coordinators shall be stop mounted, non-handed, fully automatic, and designed for sequential closing of pairs of doors with or without an astragal.
   c. Coordinators shall be designed to prevent the “active” door leaf from closing prior to the “inactive” door leaf closing, by means of a lever and trigger mechanism.
   d. Door Coordinators shall have a safety release mechanism, which will allow the “active” door leaf to close first, if put under extreme pressure, preventing damage to the door, hinges, or coordinator.
   e. Coordinator channel shall be 1-5/8” wide x 5/8” high aluminum, with variable lengths suitable to the door opening size.
   f. Filler bars shall be used in conjunction with door coordinators to cover the entire length of the door opening’s stop.
   g. Mounting brackets shall be used in conjunction with door coordinators to allow stop mounted hardware to be properly installed without damaging the door coordinators, such as parallel arm door closers or surface mounted vertical rod exit device strikes.
   h. Coordinators shall be U.L. Listed for installation on fire-labeled door openings.

M. PUSH AND PULL BARS

1. Acceptable Manufacturers:
   a. IVES, A Division of Allegion LLC.
   b. Rockwood Manufacturing Company, An ASSA ABLOY Group company (ROC)
   c. Burns Manufacturing, Inc.

2. Characteristics:
   a. Tested to be in accordance with ANSI / BHMA A156.6, Grade 1.
   b. Push and Pull Bars shall be made of 1” diameter solid bar stock. The push bars shall have a 2-1/2” projection with a 1-1/2” clearance. The pull bars shall have a minimum, 18” center-to-center length, 90 degrees offset, 3-1/2” projection, and a
2-1/2” clearance. The pull bars shall comply with the recommendations of the Americans with Disabilities Act (A.D.A.).

c. Fasteners: Furnish with one (1) 5/16-18 x 2-1/4” steel cone head machine screw with one (1) set screw, for concealed, thru-bolt, back-to-back, mounting of the common ends.

Furnish with two (2) 5/16-18 x 2-1/4” - 1” diameter decorative thru-bolts, for mounting of the free ends.

N. DOOR PULLS

1. Acceptable Manufacturers:
   a. IVES, Division of Allegion LLC.
   b. Burns Manufacturing, Inc.
   c. Rockwood Manufacturing Company, An ASSA ABLOY Group company (ROC)

2. Characteristics:
   a. Tested to be in accordance with ANSI / BHMA A156.6, Grade 1.
   b. Door Pulls shall be made of 1” diameter material, 10” Center-To-Center length, with a minimum of a 3-1/2” projection, and a 2-1/2” clearance. The door pulls shall comply with the recommendations of the Americans with Disabilities Act (A.D.A.).
   c. Furnish door pulls with 1/8” thick base washers; as indicated in the Door Hardware Sets.
   d. Fasteners: Furnish 5/16-18 x 2-1/4” machine screws with Finishing Washers, 5/16-18 x 2-1/4” machine screws with 1” Diameter Decorative Thru-Bolts.

O. PUSH PLATES

1. Acceptable Manufacturers:
   a. IVES, Division of Allegion LLC
   b. Burns Manufacturing, Inc.
   c. Rockwood Manufacturing Company, An ASSA ABLOY Group company (ROC)

2. Characteristics:
   a. Tested to be in accordance with ANSI / BHMA A156.6, Grade 1.
   b. Push Plates shall be made of .050” wrought, brass or stainless steel, material, with four beveled edges.
   c. Provide 8” x 16” plate size.
   d. Where detailed, furnish push plates cut out for a turn lever or a cylinder.
   e. Fasteners: Furnish exposed, phillips oval head, stainless steel, sheet metal screw, mounting fasteners.

P. ELECTROMAGNETIC DOOR HOLDERS

1. Acceptable Manufacturers:
   a. LCN Closers, Division of Allegion LLC.
   b. Rixson Specialty Door Controls, An ASSA ABLOY Group company (RIX).
   c. ABH Manufacturing, Inc.

2. Characteristics:
   a. Tested to be in accordance with ANSI / BHMA A156.15, Grade 1.
   b. Furnish Electromagnetic Door Holders designed to hold designated doors in an
open position when energized by an electrical current. Electromagnetic Door Holders shall be designed to operate in conjunction with U.L. Listed fire detectors and manual door closers. When the electrical current is interrupted, the holder shall become de-energized, releasing the door and allowing the manual door closer to perform its closing function.

c. Door holders shall be a Low Profile, Recessed, Wall Mount, for concealed wiring, and designed to be installed in a single outlet box, Floor Mount or frame/door mounted electro-mechanical; as indicated in the Door Hardware Sets. The outlet box shall be reinforced to withstand the shock of a door opening, preventing the box anchors from working loose. The Electrical Sub-Contractor shall be responsible for furnishing outlet boxes, electrical wiring, conduit, and all other related components.

d. Furnish door holders which can also be released by a simple manual pull on the door.

e. Door holders shall be furnished with a Fail-Safe operation. When electrical power failure occurs, doors shall release to close automatically.

f. Door holders shall be U.L. Listed for installation on smoke barrier 3-hour doors.

g. Magnets shall be protected against transients and surges up to 600 volts.

h. Voltage and Current: 120V AC, 50-60 Hz., ≤ .020 amp. maximum.

i. The door armature assembly shall be through bolt mounted and furnished with a door reinforcing plate.

j. For installations where 120V AC input voltage is required, 120V / 24V transformers are required to be furnished to reduce line voltage for 24V holding solenoids.

k. Electrical wiring of these units shall be in accordance with the National Electrical Code (ANSI / NFPA 70) for the appropriate class of circuit.

l. Final installation of these units shall be handled by and coordinated with the General Contractor's Electrical Sub-Contractor.

Q. MOP AND KICK PLATES

1. Acceptable Manufacturers:
   a. IVES, Division of Allegion LLC.
   b. Burns Manufacturing, Inc.

2. Characteristics:
   a. Tested to be in accordance with ANSI / BHMA A156.6, Grade 1.
   b. All mop and kick plates shall be US18 gauge (.050") thick of stainless steel material.
   c. Fabricate mop plates not more than 1 inch less than door width, on the “Pull” side, and kick plates not more than 1-1/2 inches less than door width, on the “Push” side; unless otherwise indicated in the Door Hardware Sets.
   d. Heights:
      (1) Mop Plates shall be 4 inches in height.
      (2) Kick Plates shall be 10 inches in height.
   e. Bevel all four (4) edges.
   f. Fabricate mop and kick plates with countersunk screw holes.
   g. Furnish mop and kick plates with #6 x 5/8” Oval Head, stainless steel, sheet metal screws.

R. SADDLE THRESHOLDS
1. Acceptable Manufacturers:
   a. National Guard Products, Inc.
   b. Pemko Manufacturing Company, An ASSA ABLOY Group company (PEM)
   c. Zero, A division of Allegion LLC.

2. Characteristics:
   a. All thresholds shall be certified by an independent testing laboratory to meet the requirements of ANSI / BHMA A156.21.
   b. All thresholds shall be in accordance with the requirements of A.D.A.A.G and 2006 IBC.
   c. Thresholds shall be furnished in an aluminum extrusion that is of alloy 6063 hardness T-5.

S. DOOR SWEEPS

1. Acceptable Manufacturers:
   a. National Guard Products, Inc.
   b. Pemko Manufacturing Company, An ASSA ABLOY Group company (PEM)
   c. ZERO, A division of Allegion LLC.

2. Characteristics:
   a. Tested to be in accordance with ANSI / BHMA A156.22.
   b. Door sweeps shall be furnished encased in a high quality aluminum extrusion that is of alloy 6063 hardness T-5.
   c. Furnish all door sweeps with densely compressed nylon filament seals, rain drip strips, and #6 x 3/4” stainless steel, truss head, sheet metal screw fasteners.

T. SELF-ADHESIVE GASKETING

1. Acceptable Manufacturers:
   a. National Guard Products, Inc.
   b. Pemko Manufacturing Company, An ASSA ABLOY Group company (PEM)

2. Characteristics:
   b. Seals shall be furnished in a compression bulb type, extruded from high grade silicone, with pressure sensitive, double backed, self-adhesive.
   c. Seals shall be classified by UL.

U. PERIMETER SEALS

1. Acceptable Manufacturers:
   a. National Guard Products, Inc.
   b. Pemko Manufacturing Company, An ASSA ABLOY Group company (PEM)

2. Characteristics:
   a. Tested to be in accordance with ANSI / BHMA A156.22.
   b. Perimeter seals shall be furnished encased in a high quality aluminum extrusion.
that is of alloy 6063 hardness T-5.

c. Where indicated in the Door Hardware Sets, furnish perimeter seals with either densely compressed nylon filament seals or a compression bulb type, extruded from high grade silicone, and #6 x 3/4” stainless steel, truss head, sheet metal screw fasteners.

V. MEETING STILE SEALS

1. Acceptable Manufacturers:
   a. National Guard Products, Inc.
   b. Pemko Manufacturing Company, Inc., An ASSA ABLOY Group company (PEM)
   c. ERO, A Division of Allegion LLC.

2. Characteristics:
   b. Meeting stile seals shall be furnished in an aluminum extrusion that is of alloy 6063 hardness T-5.
   c. Furnish all meeting stile seals with #6 x 3/4” stainless steel, truss head, sheet metal screw fasteners.

W. DRIP STRIPS

1. Acceptable Manufacturers:
   a. National Guard Products, Inc.
   b. Pemko Manufacturing Company, An ASSA ABLOY Group company (PEM)
   c. ERO, a Division of Allegion LLC.

2. Characteristics:
   a. Drip strips shall be furnished in an aluminum extrusion that is of alloy 6063 hardness T-5.
   b. Furnish all drip strips #6 x 3/4” stainless steel, truss head, sheet metal screw fasteners.

2.02 MATERIALS AND FABRICATION

A. Manufacturer’s Name Plate: Do not use manufacturers’ products that have manufacturer’s name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise acceptable to Architect.

1. Manufacturer’s identification will be permitted on rim of lock cylinders only.

B. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer’s standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI / BHMA A156 series standards for each type of hardware item and with ANSI / BHMA A156.18 for finish designations indicated. Do not furnish “optional” materials or forming methods for those indicated, except as otherwise specified.
C. Fasteners: Furnish hardware manufactured to conform to published templates, generally prepared for machine screw installation.

1. Do not furnish hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.

2. Furnish screws for installation with each hardware item. Furnish Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible, including “prepared for paint” surfaces to receive painted finish.

3. Furnish concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of adequately fastening the hardware. Coordinate with wood doors and metal doors and frames where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex screw fasteners.

2.03 HARDWARE FINISHES

A. Match items to the manufacturer’s standard color and texture finish for the latch and lock sets (or push-pull units if no latch of lock sets).

B. Furnish finishes that match those established by ANSI or, if none established, match the Architect’s sample.

C. Furnish quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with the manufacturer’s standards, but in no case less than specified by the referenced standards, for the applicable units of hardware.

D. The designations used to indicate hardware finishes are those listed in ANSI / BHMA A156.18, “Materials and Finishes”, including coordination with the traditional U.S. finishes, shown by certain manufacturers for their products.

1. Butt Hinges
   - US26D (652) Satin Chromium
   - US32D (630) Satin Stainless Steel

2. Continuous Geared Hinges
   - CL 204R1 Clear Anodized

3. Mortise Cylinders, Rim Cylinders, Thumbturn Cylinders, and “Permanent” Interchangeable Cores
   - US26D (626) Satin Chromium

4. Mortise Latchsets and Locksets
   - US26D (626) Satin Chromium

5. Deadbolts
   - 626 (US26D) Satin Chromium

6. Exit Devices
   - US32D (630) Satin Stainless Steel
7. Removable Mullions SP28 (689) Lacquer Sprayed Aluminum
8. Door Closers 689 Sprayed Silver Aluminum
9. Overhead Door Holders / Stops 652 Chrome-Like Coating on Steel
11. Floor Stops US26D (626) Satin Chromium
12. Wall Stops US32D (630) Satin Stainless Steel
13. Door Coordinators USP (715) Primed For Painting (Black)
15. Mop, Kick, and Armor Plates US32D (630) Satin Stainless Steel
16. Latch Protectors US32D (630) Satin Stainless Steel


PART 3 - EXECUTION

3.01 INSTALLATION

A. Mount hardware units at heights in accordance with the following, except as specifically indicated or required to comply with governing regulations and, except as otherwise indicated, by the Architect.

1. “Recommended Locations for Builders Hardware for Standard Steel Doors and Frames” by the Door and Hardware Institute.
2. Coordinate hardware locations not to block glazing.

B. Install each hardware item in compliance with the manufacturer’s instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.

C. Sets units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Where scheduled, Door Pulls shall be through-bolted with bolt heads concealed behind Push Plates.
E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

F. Set thresholds, for exterior and interior doors, in a full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Division 7.

G. Weatherstripping and Seals: Comply with manufacturer’s instructions and recommendations to the extent installation requirements are not otherwise indicated.

H. All cabling, conduit, connectors, patch cords, fire stop systems, data connectors, outlet & back boxes, provisions for 120 V / AC power, types of wiring required for the Access Control System, pulling of correct wiring, as specified, to appropriate locations, interfacing of security system with fire alarm system as required, and coordination of complete security system shall be furnished under the Division 26 - Electrical section for this Project.

I. The Factory Authorized Access Control System’s Supplier shall be responsible for installing the card readers, door position switches, emergency lock down stations, reader controllers, panel interface modules, expansion boards, remote RF receivers, software packages, and run low voltage wiring from the power supplies / controllers to the electrified hardware items at each opening where specified. The Access Control System’s Installer shall also be responsible for wire terminations, final hookup, testing, system setup, warranty, and Owner Turnover. Owner Training shall be furnished under this Section.

J. Upon completion of the final installation of the Door Hardware and Access Control System, and burn in of the Security System, the Contract Hardware Distributor and the Access Control System’s Supplier shall jointly make final adjustments to the electrified hardware and Access Control System’s openings to insure proper adjustment and function of the opening is in compliance with the Systems Functionality requirements.

3.02 ADJUSTING, CLEANING, AND DEMONSTRATING

A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.

1. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, the hardware installers shall return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

B. Clean adjacent surfaces soiled by hardware installation.

C. Finish Hardware Supplier’s Field Service:

1. Instruct Owner's Personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

D. Architect’s Hardware Consultant’s Field Service:

1. Inspect door hardware items for correct installation and adjustment after complete installation of the door hardware.
2. File a written report of this inspection directly to the Architect.

E. Continued Maintenance Service: Approximately six (6) months after the acceptance of hardware in each area, the Installer shall return to the project and re-adjust every item of hardware to restore proper function of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of any current or predictable problems (of substantial nature) in the performance of the hardware and furnish copy to the Owner's Agent / Representative.

3.03 HARDWARE SCHEDULE

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DOOR HARDWARE 08 71 00 - 22
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HW SET: 005 (FIRE RATED) | HW SET: 006 (FIRE RATED) | HW SET: 007 (FIRE RATED)
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**HW SET: 024A**

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**VERIFY EXISTING DOOR THICKNESS AND HINGE SIZE**

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**DOOR HARDWARE**

08 71 00 - 29
13-024  ETSU CoM Building #60 Interprofessional Education and Research Center  100% CD-R1
sbc project no. 166/005-06-2013

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<tr>
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DOOR HARDWARE  08 71 00 - 30
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<td>ROC</td>
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<tr>
<td>1</td>
<td>Storeroom Lock</td>
<td>ML2057 ASA M22 CT6</td>
<td>C-R</td>
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<tr>
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<td>Permanent Core</td>
<td>8000</td>
<td>C-R</td>
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<tr>
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<td>PRI ROC</td>
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<td>2</td>
<td>Mounting Brkt</td>
<td>2601AB</td>
<td>PRI ROC</td>
</tr>
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<td>Flush Bolt</td>
<td>555-12&quot; (Top Only)</td>
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<td>Onity Lock by Owner</td>
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<tr>
<td>1</td>
<td>Mortise Cylinder</td>
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HW Set: 038

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<td>C-R</td>
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<td>FLUSH BOLT</td>
<td>555-12&quot; (TOP ONLY)</td>
<td>626 ROC</td>
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<td>CR PADDLE LOCK</td>
<td>ML2055 HPSK CT6</td>
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<td>1</td>
<td>POWER TRANSFER</td>
<td>CEPT (FUTURE - PREP ONLY)</td>
<td>630 SEC</td>
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<td>OVHD STOP</td>
<td>9-116</td>
<td>652 RIX</td>
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<td>9-516</td>
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<td>4</td>
<td>DOOR EDGE GUARD</td>
<td>306B 42&quot; (NOTCH FOR HARDWARE)</td>
<td>630 ROC</td>
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<td>FILLER PLATE</td>
<td>EPT-1</td>
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Note: active door leaf and frame to be prepared for future power transfer

HW SET: 040

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<tr>
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<td>POCKET DOOR LOCK</td>
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<td>MORTISE CYLINDER</td>
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<td>OUTSIDE FLUSH PULL</td>
<td>O2002C X 1 3/4 DOOR</td>
<td>626 ACC</td>
</tr>
<tr>
<td>1</td>
<td>INSIDE FLUSH PULL</td>
<td>O2002T X 1 3/4 DOOR</td>
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<td>SLIDING DOOR HDWE</td>
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HW SET: 041

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<td>345D 30&quot;</td>
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<td>DRIP CAP</td>
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HW SET: 042

NOT USED   

B/O

HW SET: 043

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<td>3</td>
<td>WIDE THROW HINGE</td>
<td>T4A3786 4.5 X 8&quot;</td>
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<td>ED5470B X M54 X M55</td>
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WIDE THROW HINGES AT LOBBY LEAF
HW SET: 043A (FIRE RATED)

3 EA HINGE T4A3786 4.5 X 4.5 652 MCK
3 EA WIDE THROW HINGE T4A3786 4.5 X 8" 652 MCK
2 EA VR EXIT DEVICE ED5470B X M54 X M55 630 C-R
2 EA MAGNETIC HO FM996 689 RIX
2 EA CLOSER DC6210-M54 689 C-R
2 EA KICKPLATE K1050 10" X 35" B4E CS 630 ROC
1 SET SEALS S88D 21' PEM

WIDE THROW HINGES AT LOBBY LEAF

HW SET: 043B (FIRE RATED)

3 EA HINGE T4A3786 4.5 X 4.5 652 MCK
3 EA WIDE THROW HINGE T4A3786 4.5 X 8" 652 MCK
2 EA VR EXIT DEVICE ED5470B X M54 X M55 630 C-R
1 EA MAGNETIC HO FM996 689 RIX
1 EA ELEC. HOLD OPEN DC62930 X ET X A6 X 24D 689 C-R
2 EA CLOSER DC6210-M54 689 C-R
2 EA KICKPLATE K1050 10" X 35" B4E CS 630 ROC
1 SET SEALS S88D 21' PEM

WIDE THROW HINGES AT LOBBY LEAF
MOUNT ELECTRONIC HOLD OPEN AT CORRIDOR LEAF

HW SET: 044 (FIRE RATED)

6 EA HINGE T4A3786 4.5 X 4.5 652 MCK
1 SET AUTO FLUSH BOLTS 2848 626 ROC
2 EA MAGNETIC HO FM996 689 RIX
1 EA PASSAGE SET ML2010 ASA 626 C-R
1 EA COORDINATOR 2672 PRI ROC
2 EA CLOSER DC6210-M54 689 C-R
2 EA KICKPLATE K1050 10" X 35" B4E CS 630 ROC
1 SET SEALS S88D 21' PEM

HW SET: 045

4 EA HINGE TA2714 4.5 X 4.5 652 MCK
1 EA CR SEC LOCK ML2052 ASA 626 C-R
2 EA PERMANENT CORE 8000 626 C-R
1 EA CLOSER DC6210-M54 689 C-R
1 EA KICKPLATE K1050 10" X 34.5" B4E CS 630 ROC
1 EA WALL STOP 409 630 ROC
3 EA SILENCER 608 GRY ROC

END SECTION
SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Glass for windows, doors, interior borrowed lites, and storefront framing.
2. Glass for custom guardrail at Stair C.

B. Related Requirements:

1. Section 088113 "Decorative Glass Glazing."
2. Section 088300 "Mirrors."

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.


D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.
1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer manufacturers of insulating-glass units with sputter-coated, low-E coatings; glass testing agency and sealant testing agency.

B. Product Certificates: For glass.

C. Product Test Reports: For tinted glass, coated glass, insulating glass, and glazing sealants, for tests performed by a qualified testing agency.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.

E. Sample Warranties: For special warranties.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approve by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

E. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer’s written instructions for corrective measures including the use of specially formulated primers.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer’s written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer’s written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.12 WARRANTY

A. Manufacturer’s Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer’s written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.
B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Northwestern Industries, Inc.
2. Oldcastle BuildingEnvelope™.
4. PPG Industries, Inc.
5. Viracon, Inc.

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

1. Obtain tinted glass from single source from single manufacturer.
2. Obtain reflective-coated glass from single source from single manufacturer.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.

1. Design Wind Pressures: As indicated on Drawings.
2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
   a. Wind Design Data: As indicated on Drawings.
   b. Basic Wind Speed: 90 mph.
   c. Importance Factor: 1.0.
   d. Exposure Category: C.

3. Design Snow Loads: As indicated on Drawings.
4. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.

5. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.

6. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.

7. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glassing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glassing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glassing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.


B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
   1. Minimum Glass Thickness for Exterior Lites: 1" unless noted otherwise in pre-manufactured window specifications.
   2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with Performance Requirements Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with Performance Requirements Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
   1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
   2. Spacer: Manufacturer's standard spacer material and construction.
   3. Desiccant: Molecular sieve or silica gel, or a blend of both.
2.6 GLAZING SEALANTS

A. General:
   1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
   3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

2.8 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.9 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

   a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Presence and functioning of weep systems.
   3. Minimum required face and edge clearances.
   4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.
3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.
3.8 GLASS SCHEDULE

A. Types 1 and 2: Insulating Glass Units
   1. Refer to Specification Section 08 52 13 Clad Windows and Doors

B. Type 3
   1. Basis-of-Design Product: PPG clear float glass
   2. Overall Unit Thickness: ½ inch or thicker as required per delegated design requirements
   3. Type: Annealed float glass.

C. Type 4
   1. Basis-of-Design Product: PPG clear safety glass
   2. Overall Unit Thickness: ¼ inch or thicker as required per delegated design requirements
   3. Type: Fully Tempered float glass.
   4. Safety glazing required.

D. Type 5
   1. Basis-of-Design Product: PPG clear safety glass
   2. Overall Unit Thickness: ¼ inch or thicker as required per delegated design requirements
   3. Type: Fully Tempered float glass.
   4. Safety glazing required.
   5. Film: 3M Fasara SH2MAML Milky White (Milano)

E. Type 6
   1. Basis-of-Design Product: PPG clear float glass
   2. Overall Unit Thickness: ¼ inch or thicker as required per delegated design requirements
   3. Type: Annealed float glass.
   4. Film: SOLYX Silver 1560, mirrored silver (one way)

F. Type 7
   1. Basis-of-Design Product: PPG clear safety glass
   2. Overall Unit Thickness: ¼ inch or thicker as required per delegated design requirements
   3. Type: Fully Tempered float glass.
   4. Safety glazing required.
   5. Film: SOLYX Silver 1560, mirrored silver (one way)

G. Type 8
   1. Refer to Specification Section 08 20 23 Interior Finish Carpentry

H. Type 9
   1. Refer to Specification Section 08 81 17 Fire-Rated Glass

I. Type 10
1. Basis-of-Design Product: PPG clear safety glass
2. Overall Unit Thickness: 1 inch or thicker as required per delegated design requirements
   a. Outer Lite 1 - 1/4"
   b. Airspace
   c. Inner Lite 2 - 3/8"
3. Type: Fully Tempered float glass.
4. Safety glazing required.

END OF SECTION 08 80 00
SECTION 08 81 13 - DECORATIVE GLASS GLAZING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Decorative color glass for interior applications, with finished edges.

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI):
   1. ANSI A118.7 – Polymer-Modified Cement Grouts.

B. ASTM International (ASTM):
   1. ASTM C650 - Standard Test Method for Resistance of Ceramic Tile to Chemical Substances

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meetings: Conduct pre-installation conference at the site to coordinate Work of this Section with related work.

B. Sequencing: Schedule installation of decorative color glass to follow adjacent work against which decorative color glass terminates. Schedule installation to follow nearby work whose execution may damage completed decorative color glass work.

1.04 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's printed data sheets or catalog pages illustrating decorative color glass products and accessories.

B. Shop Drawings: Submit shop drawings prepared specifically for the Project illustrating layout, edge details, dimensions, and other data necessary for satisfactory installation that are not shown in the contract documents.
   1. Indicate decorative color glass types using designations used in this Section.

C. Samples: For each exposed product and for each color and texture specified:
   1. Decorative color glass for initial selection.
   2. Decorative color glass for verification.
   3. Size: 5 by 5 inch (127 by 127 mm).
   4. Exposed joint sealants.
   5. Exposed fasteners.
1.05 INFORMATIONAL SUBMITTALS

A. Certificates: Submit certificates required in Quality Assurance Article.

B. Test Reports:
   1. Product test reports: Submit copies of manufacturer's test reports indicating compliance with requirements.

C. Manufacturers' Instructions: Submit handling, storage, and installation instructions.

D. Warranty: Sample of proposed manufacturer warranty.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance data for decorative color glass.

1.07 MAINTENANCE MATERIAL SUBMITTALS

   1. Decorative Color Glass: Full-size units of decorative color glass equal to [five] percent of amount installed for each size indicated, but no fewer than [two] units of each size and color.

1.08 QUALITY ASSURANCE

A. Sustainability Standards Certifications: Provide the following Submittals:
   1. Credit EQ 4.1: Product data for glazing sealants and adhesives, including printed statement of VOC content.

B. Mock-ups: Build mockup of each type of decorative color glass installation to demonstrate quality standards for installation.
   1. Approved mockups may be incorporated in the completed Work.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements: Deliver materials to project site in original sealed packages, with manufacturer's label, and with storage and handling directions.

B. Storage and Handling Requirements: Store and handle materials in accordance with manufacturer's instructions.
   1. Store in clean, dry location with adequate ventilation for air circulation.
   2. Protect from damage from weather, excessive temperature and construction operations

C. Packaging Waste Management
   1. Recycle damaged material and packaging waste according to manufacturer's instructions and requirements of Division 01 Section "Construction Waste Management."

PART 2 - PRODUCTS
2.01 MANUFACTURERS

A. Manufacturers for this product include but are not limited to:
   2. Bendheim, Passaic, NJ 1-800-835-5304 www.bendheim.com

2.02 DECORATIVE COLOR GLASS, BACK-COATED

A. Back-Coated Color Glass: Mirror-quality glass with color coating applied to second surface.
   2. Glass for White and Color Coatings: ASTM C 1036 and ASTM C 1503, Mirror Select Quality; ultraclear (low-iron) float glass with a minimum 91 percent visible light transmission.
      b. Nominal Thickness: 3.0 mm.
      b. Nominal Thickness: 3.0 mm.
      c. Tint Color: Gray.
   4. Glass for Matte Coating:
      a. Basis of Design Product: Omni-Décor, Satinall
      b. Nominal Thickness: 3.0 mm.
      c. Tint Color: Low-iron (ultra white)
   5. Coating: Acrylic epoxy and protective paint layers applied to second surface and heat-cured.
   6. Color and size as indicated on drawings.

B. Sustainability Requirements:
   1. VOC Content of Interior Adhesives and Sealants: Provide installation adhesives, sealants, and sealant primers for interior use that meet the following limits for VOC content per 40 CFR 59, Part 59, Subpart D (EPA Method 24):
      a. General Adhesive: 70 g/L.
      b. Architectural Sealants: 250 g/L.

2.03 PERFORMANCE CRITERIA

A. Provide decorative color glass meeting or exceeding the following physical characteristics:

2.04 ACCESSORIES

A. Silicone Adhesive: Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25 or 50. Adhesives should always be used with additional mechanical means of support.
   1. Available Products:
a. Dow Corning 795 Silicone Building Sealant
b. Dow Corning 995 Silicone Structural Sealant
c. **Color to be approved by architect to minimize appearance of joints on substrate.**

B. **Fasteners:** Appropriate to framing or backing provided.

C. **Mirror Channels:** Clear anodized aluminum matched set of top and bottom channels, width to match decorative color glass thickness.

### 2.05 FABRICATION

A. **Decorative Color Glass:** Cut decorative color glass to sizes required for Project. Fabricate cutouts without damage to visible surfaces, closely fitting penetrations.

B. **Glass Edge Treatment:** Flat polished.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

A. **Verification of Conditions:** Verify that substrates to receive decorative color glass are plumb, level, smooth, clean, dry, and sound. Correct deficiencies prior to commencing installation.

B. **Verify compatibility of proposed adhesives with substrate.**

#### 3.02 PREPARATION

A. **Surface Preparation:** Comply with adhesive manufacturer's recommendations. Correct minor defects in substrate using leveling compounds acceptable to decorative color glass and adhesive manufacturer. Prime substrate where recommended. Prepare substrate to match color of back painted glass at sealant joints to minimize joint appearance.

### 3.03 DECORATIVE COLOR GLASS INSTALLATION

A. **Wall-Mounted Decorative Color Glass:** Install decorative color glass units in accordance with manufacturer’s recommendations and approved shop drawings.

B. Install glass units with adhesive and mirror mounting hardware (top and bottom of grouping only – not at intermediate joints). Mechanically attach glass trim units securely to substrates with fasteners installed with anchors or inserts.

1. **Mirror Channels:** Install set of channels along top and bottom of installation, adjusting so channels are level and evenly spaced. Cut glass to exact length required to set into channels with full support. Apply adhesive to substrate and set glass.
2. **Adhesive:** Apply barrier coat to mirror backing when recommended by mirror and adhesive manufacturer. Apply adhesive as recommended by manufacturer. Align glass units and press into place. Adhesive should be used with mechanical fastener or additional support.
3. **Seal:** Align units using 1/8 inch (3 mm) spacers to allow for even sealant joints.
C. Tolerances: Install decorative color glass to allow for anticipated structural movement. Space selected units 1/32 inch horizontally, paint backing substrate where vertical joint may open over time. Allow for vertical settling between decorative glass units and adjacent components.

3.04 CLEANING

A. Wash exposed surfaces of decorative color glass as recommended by manufacturer not more than three days prior to scheduled inspection for Substantial Completion.

3.05 PROTECTION

A. Protect decorative color glass from damage resulting from construction activities.

END OF SECTION 08 81 13
SECTIO 08 81 17 - FIRE-RATED GLASS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fire-rated glazing materials installed as vision lights in fire-rated doors.

B. Related Sections include the following:
   1. Section 08 11 00 “Metal Doors and Frames” for vision panels in interior doors and interior vision panel (borrowed lites) frames.
   2. Section 08 14 16 “Flush Wood Doors” for vision panels in interior doors.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

B. American National Standards Institute (ANSI):

C. Consumer Product Safety Commission (CPSC):

D. Glass Association of North America (GANA):

E. National Fire Protection Association (NFPA):

F. Underwriters Laboratories, Inc. (UL):
   1. UL 9 – Fire Tests of Window Assemblies.
   2. UL 10B – Fire Tests of Door Assemblies.
   3. UL 10C – Positive Pressure Fire Tests of Door Assemblies.

G. Standard Council of Canada:
   1. ULC Standard CAN4-S104: Fire Tests of Door Assemblies.
   2. ULC Standard CAN4-S106: Fire Tests of Window Assemblies.

H. Adopted Building Code
   1. IBC 2006.

1.3 DEFINITIONS
A. Manufacturer: A firm that produces primary glass, fabricated glass or framing as defined in referenced glazing publications.

1.4 SUBMITTALS

A. Comply with requirements of Section 01 33 00 Submittal Procedures.

B. Product Data: Submit manufacturer’s technical data for each glazing material required, including installation and maintenance instructions.

C. Certificates of compliance from glass and glazing materials manufacturers attesting that glass and glazing materials furnished for project comply with requirements. Separate certification will not be required for glazing materials bearing manufacturer’s permanent label designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authority having jurisdiction.

D. Product Test Listings: From UL indicating fire-rated glass complies with requirements, based on comprehensive testing of current product.

E. Samples: Submit, for verification purposes, approx. 8-inch by 10-inch sample for each type of glass indicated.

1.5 QUALITY ASSURANCE


B. Fire Protective Rated Glass: Each lite shall bear permanent, non-removable label of UL certifying it for use in tested and rated fire protective assemblies.

C. Fire Protective Glazing Products for Door Assemblies: Products identical to those tested per UL 10B, classified and labeled by UL.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials under provisions of Section 01 73 00 Execution.

B. Deliver materials to specified destination in manufacturer or distributor’s packaging, undamaged, complete with installation instructions.

C. Store off ground, under cover, protected from weather and construction activities.

1.7 WARRANTY

A. Provide manufacturer’s limited warranty under provision of Section 01 78 21 Closeout Procedures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS- (ACCEPTABLE MANUFACTURER/PRODUCTS)
A. Manufacturers
1. FireLite Plus - Technical Glass Products
2. SuperLite X-60 and X-90 - SAFTIFIRST.
3. Keralite Filimed - Vetrotech

B. Requests to use equivalent products of other manufacturers shall be submitted in accordance with Section 01 25 13 - Product Substitution Procedures.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-rated glass ceramic clear and wireless glazing material listed for use in impact safety-rated locations such as borrowed lites with fire rating requirements ranging from 60 to 90 minutes with required hose stream test.

B. Passes positive pressure test standards UL 10C.

2.3 MATERIALS-GLASS

A. Properties:
2. Weight: approximately 4 lbs./sq. ft.
5. Fire-rating:
   a. 60 minutes at 1HR Fire Barrier
   b. 90 minutes at 2HR Fire Barrier
7. STC Rating: Approximately 38 dB.
8. Surface Finish:
   a. Standard Grade is polished for a surface quality that is comparable to alternative fire-rated ceramics marketed as having a premium finish.
9. Positive Pressure Test: UL 10C; passes.

B. Maximum sheet sizes based on surface finish:

C. Labeling: Permanently label each piece of glazing with the manufacturer's logo, UL logo and fire rating in sizes up to 3,325 sq. in., and with the manufacturer's label only for sizes that exceed the listing (as approved by the local authority having jurisdiction).

D. Fire Rating: Fire rating classified and labeled by UL for fire rating scheduled at opening locations on drawings, when tested in accordance with ASTM E2010-01, NPFA 252, UL 10B and UL 10C.

2.4 GLAZING COMPOUND FOR FIRE-RATED GLAZING MATERIALS

A. Silicone Sealant: One-part neutral curing silicone, medium modulus sealant, Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable. Available Products:
1. Dow Corning 795 - Dow Corning Corp.
2. Silglaze-II 2800 - General Electric Co.
3. Spectrem 2 - Tremco Inc.]
B. Setting Blocks: Neoprene, EPDM, or silicone; tested for compatibility with glazing compound; of 70 to 90 Shore A hardness.

C. Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.

2.5 FABRICATION

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine glass framing, with glazier present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.
   2. Minimum required face or edge clearances.
   3. Observable edge damage or face imperfections.

B. Do not proceed with glazing until unsatisfactory conditions have been corrected.

C. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

3.2 INSTALLATION (GLAZING)

A. Comply with referenced FGMA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.

B. Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.

C. Set units of glass in each series with uniformity of pattern, draw, bow, and similar characteristics.

D. Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation.

E. Place setting blocks located at quarter points of glass with edge block no more than 6 inches from corners.

F. Glaze vertically into labeled fire-rated metal frames or partition walls with same fire rating as glass and push against tape for full contact at perimeter of pane or unit.

G. Place glazing tape on free perimeter of glazing in same manner described above.

H. Use specified glazing compound, without adulteration; bed glazing material in glazing compound; entirely fill all recess and spaces. Provide visible glazing compound with smooth and straight edges.

I. Install in vision panels in fire-rated doors to requirements of NFPA 80.
J. Install so that appropriate UL and manufacturer markings remain permanently visible.

3.3 PROTECTION AND CLEANING

A. Protect glass from contact with contaminating substances resulting from construction operations. Remove any such substances by method approved by glass manufacturer.

B. Wash glass on both faces not more than four days prior to date scheduled for inspections intended to establish date of substantial completion. Wash glass by method recommended by glass manufacturer.

3.4 GLAZING SCHEDULE

<table>
<thead>
<tr>
<th>Rating</th>
<th>Assembly</th>
<th>Max. Exposed Area (Sq. In.)</th>
<th>Max. Width Of Exposed Glazing (In.)</th>
<th>OR</th>
<th>Max. Height Of Exposed Glazing (In.)</th>
<th>Stop Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 min.</td>
<td>Doors (non-temp rise)</td>
<td>100</td>
<td>12</td>
<td>33</td>
<td></td>
<td>5/8&quot;</td>
</tr>
<tr>
<td></td>
<td>HMS or Wood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90 min.</td>
<td>Doors (non-temp rise)</td>
<td>100</td>
<td>12</td>
<td>33</td>
<td></td>
<td>1/2&quot;</td>
</tr>
</tbody>
</table>

* HMS indicates hollow metal steel framing.

END OF SECTION 08 81 17
SECTION 08 83 00 - MIRRORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following types of silvered flat glass mirrors:
   1. **Film-backed, Tempered** glass mirrors qualifying as safety glazing.

B. Related Requirements:
   1. Section 102800 "Toilet, Bath, and Laundry Accessories" for metal-framed mirrors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.

B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

C. Samples: For each type of the following:
   1. Mirrors: **12 inches (300 mm)** square, including edge treatment on two adjoining edges.
   3. Mirror Trim: **12 inches (300 mm)** long.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of mirror and mirror mastic.

C. Preconstruction Test Reports: From mirror manufacturer indicating that mirror mastic was tested for compatibility and adhesion with mirror backing and substrates on which mirrors are installed.

D. Sample Warranty: For special warranty.
1.5 CLOSEOUT SUBMITTALS
   A. Maintenance Data: For mirrors to include in maintenance manuals.

1.6 QUALITY ASSURANCE
   A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.7 PRECONSTRUCTION TESTING
   A. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing.
      1. Testing is not required if data are submitted based on previous testing of mirror mastic products and mirror backing matching those submitted.

1.8 DELIVERY, STORAGE, AND HANDLING
   A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
   B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.9 FIELD CONDITIONS
   A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.10 WARRANTY
   A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
      1. Warranty Period: Five years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 SILVERED FLAT GLASS MIRRORS

A. Mirrors, General: Clear float tempered safety type with copper and silver coating, organic overcoating, beveled edges 1/4" inch thick, with safety film. Sizes as shown on Drawings. Back of mirror shall be fully taped to prevent fragments of falling glass in event of breakage.

2.2 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.3 MIRROR HARDWARE

A. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.

1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch (9.5 and 22 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).

2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch (16 and 25 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).

3. Finish: **Clear** bright anodized.

B. Mirror Top Clips: **As indicated**

C. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

D. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.4 FABRICATION

A. Fabricate mirrors in the shop to greatest extent possible.
B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

C. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint, as recommended in writing by film-backing manufacturer, to produce a surface free of bubbles, blisters, and other imperfections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.

C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

A. Comply with mastic manufacturer’s written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer’s special bond coating where applicable.

3.3 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer’s written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

1. GANA Publications: [Laminated Glazing Reference Manual], "Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

B. Provide a minimum airspace of 1/8 inch (3 mm) between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

C. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

1. Aluminum J-Channels: Provide setting blocks 1/8 inch (3 mm) thick by 4 inches (100 mm) long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch (6.4 mm) wide by 3/8 inch (9.5 mm) long at bottom channel.

2. Aluminum J-Channels and Cleat: Fasten J-channel directly to wall and attach top trim to continuous cleat fastened directly to wall.

3. Mirror Clips: Place a felt or plastic pad between mirror and each clip to prevent spalling of mirror edges. Locate clips so they are symmetrically placed and evenly spaced.

4. Install mastic as follows:
a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of 1/8 inch (3 mm) between back of mirrors and mounting surface.

3.4 CLEANING AND PROTECTION

A. Protect mirrors from breakage and contaminating substances resulting from construction operations.

B. Do not permit edges of mirrors to be exposed to standing water.

C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 088300
SECTION 08 91 19 - FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Fixed, extruded-aluminum louvers.

B. Related Requirements:
   1. Section 081113 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.
   2. Section 081416 "Flush Wood Doors" for louvers in flush wood doors.
   3. Section 099000 "Painting" for field-painting interior louvers.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).

C. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
   1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
   2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.
D. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

B. Windborne-debris-impact-resistance test reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

C. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. See notes on structural drawings for Sds, Importance Factor.
D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer’s stock units identical to those provided, except for length and width according to AMCA 500-L.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.


2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Wind-Driven-Rain-Resistant Louver - Typical at all exterior louvers:
   a. Airolite Company, LLC (The).
   b. Construction Specialties, Inc
   c. Ruskin Company.

2. Louver Depth: 5 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.060 inch for blades and 0.080 inch for frames.
4. Louver Performance Ratings:
   a. Free Area: Not less than 7.2 sq. feet for 48-inch-wide by 48-inch-high louver.
   b. Air Performance: Not more than 0.10-inch wg (25-Pa) static pressure drop at 550-fpm (2.8-m/s) free-area exhaust / intake velocity.
   c. Wind-Driven Rain Performance: Not less than 95 percent effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph at a core-area intake velocity of 300 fpm.

5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.
   1. Screen Location for Fixed Louvers: Interior face.
   2. Screening Type: Bird/Insect screening.

B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
   1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
   2. Finish: Same finish as louver frames to which louver screens are attached.
   3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:
1. Bird/Insect Screening: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh, 0.012-inch (0.30-mm) wire.

2.5 BLANK-OFF PANELS

A. Insulated, Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.
   1. Thickness: 1 inch (25 mm).
   2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch (0.81-mm) nominal thickness.
   3. Insulating Core: extruded-polystyrene foam.
   4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch (2.03-mm) nominal thickness, with corners mitered and with same finish as panels.
   5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
   6. Panel Finish: Same type of finish applied to louvers, but black color.
   7. Attach blank-off panels with clips.

2.6 MATERIALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.

D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, No. 2B finish.

E. Fasteners: Use types and sizes to suit unit installation conditions.
   1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
   2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
   3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
   4. For fastening stainless steel, use 300 series stainless-steel fasteners.
   5. For color-finished louvers, use fasteners with heads that match color of louvers.

F. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.7 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern.
2. Horizontal Mullions: Provide horizontal mullions at joints.

C. Maintain equal louver blade spacing to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Channel unless otherwise indicated.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.

1. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.

G. Provide subsills made of same material as louvers for recessed louvers.

H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.8 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: Dark bronze, to be confirmed by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 08 91 19
SECTION 09 03 20 - HISTORIC TREATMENT OF PLASTER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Repair of historic interior and exterior lime plaster.
   2. Repair and replacement of interior gypsum plaster.

B. Related Requirements:
   1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
   2. Section 061000 "Rough Carpentry" for wood framing, grounds, and furring that support lath and plaster.
   3. Section 090391 "Historic Treatment of Plain Painting" for paint removal, surface preparation for refinishing, and refinishing of historic plaster surfaces.
   4. Section 092216 "Non-Structural Metal Framing" for non-load-bearing steel framing and furring that support lath and plaster.
   5. Section 092613 "Gypsum Veneer Plastering" for gypsum-based veneer plaster applied on gypsum base for veneer plaster, unit masonry, and monolithic concrete.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of plaster.
   2. Review methods and procedures related to historic treatment of plaster including, but not limited to, the following:
      a. Verify historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
      b. Materials, material application, colors, patterns, and sequencing.
      c. Fire-protection plan.
      d. Plasterwork historic treatment program.
      e. Coordination with building occupants.
1.4 SEQUENCING AND SCHEDULING

A. Perform historic treatment of plaster in the following sequence, which includes work specified in this and other Sections:

1. Dismantle existing surface-mounted objects and hardware that overlie plaster surfaces except items indicated to remain in place. Tag items with location identification and protect.
2. Verify that temporary protections have been installed.
3. Examine condition of plaster surfaces.
4. Clean plaster surface and remove paint and other finishes to the extent required.
5. Repair and replace existing plaster and supports to the degree required for a uniform, tightly adhered surface on which to paint or apply other finishes.
6. Cure repaired surfaces and allow them to dry for proper finishing.
7. Paint and apply other finishes.
8. Reinstall dismantled surface-mounted objects and hardware unless otherwise indicated.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include recommendations for product application and use.

B. Samples for Verification: For the following products:
   1. Wood Lath: 18-inch- (450-mm-)long section.
   2. Metal Lath: 18 inches (450 mm)square.
   3. Accessories: Each type in manufacturer’s standard size.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified historic treatment specialist.

B. Plasterwork Historic Treatment Program: Submit before work begins.

1.7 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic plastering specialist with expertise in matching and performing the types of historic plasterwork repairs required. Experience only in installing and repairing new plasterwork, veneer plaster, or gypsum board is insufficient experience for historic treatment work.

B. Plasterwork Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for historic treatment work and protection of surrounding materials and Project site.
   1. Include methods and procedures to protect plastered surfaces from damage caused by construction operations, including, but not limited to, exposure to moisture, vibration, mechanical damage, and soiling.
2. If materials and methods other than those indicated are proposed for any phase of historic treatment work, add a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.

C. Mockups: Prepare mockups of historic treatment processes for each type of plaster repair and reconstruction work to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Locate mockups on existing surfaces where directed by Architect or in locations that enable viewing under same conditions as the completed Work.
2. Number and Size: Two wall surfaces of at least 50 sq. ft. (4.5 sq. m) or approximately 48 inches in least dimension to represent surfaces and conditions for application of each type of plaster repair and reconstruction under same conditions as the completed Work. Include at least the following:
   a. Install 4-sq. ft. (4-sq. m) area of wet-applied plaster replacement with grooves simulating stone joints, at exterior steps
   b. Patch 10-sq. ft. (1-sq. m) area of wet-applied plaster replacement with grooves simulating existing stone, at existing exterior steps at south elevation.
   c. Repair 3 linear ft. (1 m) of plaster cracks.
   d. Reattach 4-sq. ft. (4-sq. m) area of delaminated plaster that has not fallen.

3. Simulate finished lighting conditions for review of mockups.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

B. Store materials on elevated platforms, under cover, and in a dry location with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

C. Store hydrated lime and factory-prepared lime putty in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

D. Store materials not in use in tightly covered containers.

E. Store lime putty covered with water in sealed containers.

F. Store sand where grading and other required characteristics can be maintained and contamination avoided.

G. Handle cast-plaster fabrications to prevent overstressing, chipping, defacement, and other damage.
1.9 FIELD CONDITIONS

A. Comply with plaster-material manufacturers' written instructions. For gypsum plaster, also comply with ASTM C 842 requirements.

B. Temperatures: Maintain temperatures in work areas at not less than 55 deg F (13 deg C) or greater than 80 deg F (27 deg C) for at least seven days before application of plaster, continuously during application, and for seven days after plaster has set or until plaster has dried.

C. Conditioning: Acclimatize cast-plaster fabrications to ambient temperature and humidity of spaces in which they are installed. Remove packaging and move units into installation spaces not less than 48 hours before installing them.

D. Field Measurements: Where cast-plaster fabrications are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

E. Avoid conditions that result in plaster drying out too quickly.
   1. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
   2. Maintain relative humidity levels for prevailing ambient temperature that produce normal drying conditions.
   3. Ventilate work areas in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.

1.10 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform testing on existing interior and exterior plaster as follows:
   1. Provide test specimens as indicated and representative of proposed materials and existing construction. Take test specimens from each different type of substrate, including interior face of exterior brick walls, interior brick walls, interior stud walls and interior ceilings.
   2. The Contractor shall submit the laboratory report from completed plaster analysis. Plaster analysis shall be completed prior to beginning test panel preparation. Analysis shall be limited to ASTM 1324 wet chemical and microscopic analysis to characterize the insoluble aggregate, determine binder-aggregate ratio, prepare a mix design for replacement plaster, and identify appropriate sources for sand aggregate.

PART 2 - PRODUCTS

2.1 LIME-PLASTER MATERIALS

A. Hydrated Lime: ASTM C 206, Type S or Type N as determined to match existing.

B. Lime Putty: Slaked hydrated lime or factory-prepared lime putty according to ASTM C 1489 as determined to match properties of existing.

1. **Finish-Coat Sand**: Match size, texture, and gradation of existing sand as closely as possible. Blend several sands if necessary to achieve suitable match.

D. **Pigments for Colored Plaster**: ASTM C 979/C 979M and having a record of satisfactory performance in lime plaster.

E. **Fiber**: 1/2 to 1 inch (13 to 25 mm) in length; composed of natural material matching composition and texture of existing plaster; free of grease, waxes, and oils; and beaten well to separate fibers before blending into unfibered plaster material.

1. **Proportion of Fiber to Unfibered Plaster Material**: 3.5 oz./cu. ft. (3.5 g/L) of unfibered plaster material, adjusted as required to produce a well-fibered, cohesive, spreadable, stiff mix with fibers uniformly distributed.

F. **Fabric Reinforcing**: Coarse, open-weave, sackcloth made of natural linen, cotton, hemp, or jute; free of grease and oils to match existing plaster; free of grease, waxes, and oils.

### 2.2 GYPSUM PLASTER MATERIALS

A. **Gypsum Materials**:

3. **Gypsum Wood-Fibered Plaster**: ASTM C 28/C 28M.
4. **High-Strength Gypsum Neat Plaster**: ASTM C 28/C 28M; with a minimum, average, dry compressive strength of 2800 psi (19 MPa) per ASTM C 472 for a mix of 100 lb (45 kg) of plaster and 2 cu. ft. (0.06 cu. m) of sand.
5. **Gypsum Gaging Plaster**: ASTM C 28/C 28M.
6. **High-Strength Gypsum Gaging Plaster**: ASTM C 28/C 28M; with a minimum, average, dry compressive strength of 5000 psi (34 MPa) per ASTM C 472 for a neat mix.
8. **Gypsum Keene's Cement**: ASTM C 61/C 61M.

B. **Hydrated Lime**: ASTM C 206, Type S or Type N as determined to match existing plaster

C. **Aggregates**:

1. **Aggregate for Base-Coat Plasters**: ASTM C 35, sand.
2. **Aggregate for Float Finishes**: ASTM C 35, sand; graded per ASTM C 842.

D. **Fiber**: 1/2 to 1 inch (13 to 25 mm) in length; composed of natural material compatible and matching in appearance to existing plaster; free of grease, waxes, and oils; and beaten well to separate fibers before blending into unfibered plaster material.

1. **Proportion of Fiber to Unfibered Plaster Material**: 3.5 oz./cu. ft. (3.5 g/L) of unfibered plaster material, adjusted as required to produce a well-fibered, cohesive, spreadable, stiff mix with fibers uniformly distributed.
E. Fabric Reinforcing: Coarse, open-weave, sackcloth made of natural linen, cotton, hemp, or jute; free of grease and oils, matching existing plaster; free of grease, waxes, and oils.

F. Bonding Compound: ASTM C 631.

2.3 LATH

A. Wood Lath: 1/4 inch by 1-1/4 inch (6 mm by 32 mm) sound, straight-grained, wood strips

B. Metal Lath:

   a. Paper Backing: Kraft paper factory bonded to back of lath.
   b. Diamond-Mesh Lath: Flat or Self-furring as required to match surrounding existing areas. Weight as recommended by manufacturer for application.

2.4 TRIM ACCESSORIES

A. General: According to ASTM C 1063 for lime plaster and ASTM C 841 for gypsum plaster; coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

3. Cornerbeads: Fabricated from zinc or zinc-coated (galvanized) steel.
   a. Small nose cornerbead with expanded flanges; use unless otherwise indicated.
   b. Small nose cornerbead with perforated flanges; use on curved corners.
   c. Small nose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
   d. Bull nose cornerbead, radius of 3/4 inch (19 mm) minimum, with expanded flanges; use at locations indicated on Drawings.
4. Casing Beads: Fabricated from zinc or zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
5. Control Joints: Fabricated from zinc or zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
6. Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
7. Two-Piece Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4 to 5/8 inch (6 to 16 mm) wide; with perforated flanges.
2.5 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fasteners for Attaching Lath to Substrates:
   1. For Lime Plaster: ASTM C 1063.
   2. For Gypsum Plaster: ASTM C 841.
   3. For Wood Lath: ASTM C 841 requirements for wood-floor-runner or wood-furring fasteners unless otherwise indicated on Drawings.

C. Wire Ties: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter, unless otherwise indicated.

D. Plaster-Stabilization Materials: Acrylic emulsion(s) and related installation products shall have proven effectiveness in reattaching delaminated plaster and shall have been used previously by historic treatment specialist with successful results.
   1. Acrylic Emulsion(s), General: Aqueous emulsion(s) of acrylic polymer, adhesive to plaster and plaster substrates, nontoxic, and non-reemulsifiable after curing.
   2. Prewet Solution: Low-viscosity acrylic emulsion.
   3. Adhesive: Thickened acrylic emulsion; thickener as recommended in writing by resin manufacturer and historic treatment specialist.

E. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:
   1. Previous effectiveness in performing the work involved.
   2. Little possibility of damaging exposed surfaces.
   3. Consistency of each application.
   4. Uniformity of the resulting overall appearance.
   5. Do not use products or tools that could do the following:
      a. Remove, alter, or in any way harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in contact.
      b. Leave an unintended residue on surfaces.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT OF PLASTER, GENERAL

A. Historic Treatment Appearance Standard: Completed work is to have a uniform appearance as viewed by Architect from building interior at 5 feet (1.5 m) away from surface and from building exterior at 20 feet (6 m) away from surface.

B. General: In treating historic plaster, disturb it as minimally as possible and as follows unless otherwise indicated:
1. Dismantle loose, damaged, or deteriorated plaster, lath, and support systems that cannot be repaired.
2. Verify extent of plaster deterioration against that indicated on Drawings. Consult Architect on types and extent of required work.
3. Verify that substrate surface conditions are suitable for repairs.
4. Provide lath, furring, and support systems for plaster included in the work of this Section.
5. Replace lost details in new, wet-applied and cast plaster that replicate existing or indicated plaster configurations.
6. Leave repaired plasterwork in proper condition for painting or applying other finishes as indicated.
7. Install temporary protective measures to protect historic surfaces that shall be treated later.

C. Illumination: Perform plastering work with adequate, uniform illumination that does not distort the flatness or curvature of surfaces.

3.2 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate and environmental conditions, installation tolerances, and other conditions affecting performance of the Work.

1. If existing substrates cannot be prepared to an acceptable condition for plastering work, notify Architect in writing.
2. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.


C. Begin historic plastering work only after unsatisfactory conditions have been corrected.

3.3 PREPARATION FOR PLASTERING

A. Substrates: Prepare according to plaster manufacturer’s written instructions and as follows:

1. Clean surfaces to remove dust, loose particles, grease, oil, incompatible curing compounds, form-release agents, and other foreign matter and deposits that could impair bond with plaster.
2. Remove ridges and protrusions greater than 1/8 inch (3 mm) and fill depressions greater than 1/4 inch (6 mm) with patching material. Allow to set and dry.

3.4 PLASTER REMOVAL AND REPLACEMENT, GENERAL

A. Dismantle plaster that is damaged or deteriorated to the limits indicated. Carefully dismantle areas along straight edges that lie over supports, without damaging surrounding plasterwork.

B. Maintain lath and supporting members in an undamaged condition so far as practicable. Dismantle damaged lath and supports that cannot be repaired or resecured and replace with new work of same type.
C. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.

D. Do not deviate more than plus or minus 1/8 inch in 10 feet (3 mm in 3 m) from a true plane in finished plaster surfaces, as measured by a 10-foot (3-m) straightedge placed on surface.

E. Clean substrate surfaces to remove grease, waxes, oils, waterborne staining, debris, and other foreign matter and deposits that could impair bond with repair material.

F. Wet wood lath masonry and concrete bases before plaster application. Keep substrate damp to the touch but without visible water droplets.

G. Wet remaining plaster abutting the replacement plaster before installing new plasterwork.

H. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.

I. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

3.5 FLAT LIME-PLASTER REMOVAL AND REPLACEMENT

A. General: Dismantle deteriorated plaster to existing sound plaster.

1. Inspect for lath deterioration. If any, replace lath.
2. Sand bonding surfaces of repair area, and clean the surface with a nonmetallic bristle brush.
3. Wet substrate to damp condition, but without visible water droplets, then install new plaster to original profiles.

B. Lime-Plaster Base Coats:

1. Scratch Coat: Mix as determined to match existing plaster. Add fiber to mix and evenly distribute it without clumps just before spreading.
2. Brown Coat: Lime Putty and Sand as required to match existing plaster.

C. Lime-Plaster Finish Coats:

1. Finish-Coat Mix for Smooth-Troweled Finish: Lime putty and sand as required to match finish of existing plaster.
2. Finish-Coat Mix for Smooth-Float Finish: Lime putty and sand as required to match finish of existing plaster.
3. Finish-Coat Mix for Sandy Float Finish: Lime putty and sand as required to match finish of existing plaster.
4. Lime-Plaster Finishes: Lime putty and sand as required to match finish of existing plaster.

D. Hairline cracking within the plaster or plaster separation at edge of a replacement is unacceptable. Completely dismantle such work and reinstall or repair as a crack repair.
3.6 FLAT GYPSUM-PLASTER REMOVAL AND REPLACEMENT

A. General: Dismantle deteriorated plaster to existing sound plaster. Use replacement plaster mixes of gypsum, lime, and aggregate; and application according to ASTM C 842 unless otherwise indicated.
   1. Inspect for lath deterioration. If any, replace lath.
   2. Sand bonding surfaces of repair area, and clean the surface with a nonmetallic bristle brush.
   3. Wet substrate to damp condition, but without visible water droplets, then install new plaster to original profiles.

B. Bonding Compound: Apply on unit masonry plaster bases.

C. Gypsum-Plaster Base Coats:
   1. Base Coats over Wood Lath: Gypsum plaster with job-mixed sand and fiber as required to match existing plaster.
   2. Base Coats over Expanded-Metal Lath Gypsum plaster with job-mixed sand and fiber as required to match existing plaster.
   3. Base Coats over Unit Masonry and Concrete: Gypsum plaster with job-mixed sand and fiber as required to match existing plaster.

   3. Gypsum-Plaster Finish Coats:
      a. Gypsum plaster textured as required to match existing adjacent plaster.
      b.

3.7 REMOVING AND INSTALLING LATH AND ACCESSORIES

A. General: Dismantle existing plaster as necessary to expose deteriorated or rusted lath, wire ties, and support system, back to firm substrates and supports. Repair with new materials, well secured to existing lath in good condition and to building structure.

   1. Cutting: Cut lath so it can be taken out completely from one support to the next. Cut to avoid cracking surrounding plaster.
   2. Cut out existing base-coat plaster beyond the edges of the new lath to permit new plaster to extend onto the old lath. Then step subsequent plaster coats to permit new plaster to extend over the old material.
   3. Fasten new lath to support system and to good existing lath. Wire tie at least every 6 inches (150 mm).
   4. Install new lath according to ASTM C 1063 for lime plaster and ASTM C 841 for gypsum plaster.

B. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.

C. Wood Lath: Install wood lath in same orientation and spacing as remaining wood lath and with lath ends supported by furring or framing. Stagger ends of adjacent laths over different supports, not aligned, and secure with fasteners at each end and spaced a maximum of 24 inches (610 mm) o.c. into supports.

D. Metal Lath: Install according to ASTM C 1063 for lime plaster and ASTM C 841 for gypsum plaster.
3.8 PATCH-TYPE REPAIR

A. General: Patch voids, fractured surfaces, and crushed areas in otherwise sound plaster that are larger than cracks at locations indicated on Drawings.

1. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.
2. Inspect for deterioration of supporting plaster and lath, and repair or replace deteriorated material as required for a sound substrate.
3. Rake perimeter of hole to sound plaster, and slightly undercut existing plaster to enable replacement plaster to tuck behind existing plaster.
4. Replace missing lath in kind. Bridge gaps in wood lath with expanded-metal lath, overlapping wood by 6 inches (150 mm) and fastening them together.
5. Clean hole to remove loose materials and other foreign matter and deposits that could impair bond with repair material. Where grease, waxes, oils, waterborne staining, or other foreign matter and deposits that could impair bond with repair material have penetrated into the plaster, enlarge the hole to remove these deposits.
6. Wet substrate to damp condition, but without visible water droplets, then install patch material to original profiles.
7. Maintain adjacent plasterwork in an undamaged condition so far as practicable.

B. Lime-Plaster Mix: Repair mix demonstrated in mockup.

C. Gypsum-Plaster Mix: Repair mix demonstrated in mockup.

D. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster. For molded plaster shapes, tool surface to restore the sharp edges and the shape of the molded shape to original contours.

E. Hairline cracking within the plaster or plaster separation at edge of a patch is unacceptable. Completely dismantle such work and reinstall or repair.

3.9 HAIRLINE CRACK REPAIR

A. General: Repair cracks 1/32 inch (1 mm) in width or narrower in otherwise sound plaster.

1. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.
2. Maintain adjacent plasterwork in an undamaged condition so far as practicable.

B. Existing Topcoat: Open crack in existing topcoat to at least 1/8 inch (3 mm) in width and check for broken fiber reinforcement in base coats.
C. Existing Base Coats: Do not open crack wider in existing base coats unless inspection or other indication shows that the fiber reinforcement has broken. Where inspections indicate failure of fiber reinforcement, proceed as for a large crack repair, but only for length of crack with broken fiber reinforcement.

D. Clean out crack to remove loose materials and other foreign matter and deposits that could impair bond with repair material. Where grease, waxes, oils, waterborne staining, or other foreign matter and deposits that could impair bond with repair material have penetrated into the topcoat plaster, widen the crack and sand surface of the exposed basecoat to remove these deposits.

E. Wet substrate to damp condition, but without visible water droplets.

F. Force repair material demonstrated in mockup into crack, filling crack to original plaster profile.

G. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster. For molded plaster shapes, tool surface to restore the sharp edges and the shape of the molded shape to original contours.

3.10 LARGE CRACK REPAIR

A. General: Repair cracks over 1/32 inch (1 mm) in width in otherwise sound plaster.

1. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.

2. Maintain adjacent plasterwork in an undamaged condition so far as practicable.

B. Open crack to at least 1/8 inch (3 mm) Insert dimension in width and full depth with V-groove tool, and check for bond separation or lath deterioration.

C. Abrade side surfaces of crack and remove inner crack debris by gouging (keying) the inside area of the crack.

D. Clean out crack to remove loose materials and other foreign matter and deposits that could impair bond with repair material. Where grease, waxes, oils, waterborne staining, or other foreign matter and deposits that could impair bond with repair material have penetrated into the plaster, widen the crack to remove these deposits.

E. Wet substrate to damp condition, but without visible water droplets.

F. Install repair material demonstrated in mockup to fill crack to original plaster profile.

G. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster. For molded plaster shapes, tool surface to restore the sharp edges and the shape of the molded shape to original contours.

H. Offset Cracks: If the crack is offset in surface plane by more than 1/8 inch (3 mm), dismantle the plaster on each side of the crack, a minimum width of 6 inches (150 mm) and down to the lath or other substrate. Then, repair as specified for flat-plaster removal and replacement.

3.11 REATTACHMENT OF DELAMINATED PLASTER

A. General: Reattach plaster that has detached from its wooden lath.
1. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.
2. Maintain adjacent plasterwork in an undamaged condition so far as practicable.

B. Verify extent of detachment of plaster that has not yet fallen by tapping on plaster surface and evaluating the hollow or solid resonance.

C. Protect floors from spillage and debris in the vicinity of work. Use materials resistant to the passage of fluids used in work.

D. Drill 1/4-inch (6-mm) injection ports (holes) through the plaster spaced 3 to 6 inches (75 to 150 mm) apart over surface of detached plaster. Dislodge loose plaster particles, and vacuum debris from holes.

E. Prewet injection ports, gaps at edges of lost plaster, back of plaster, and wooden lath with prewet solution.

F. Inject adhesive into ports, enough to fill gaps between detached plaster and lath, and inject into gaps at edges of lost plaster.

G. Clean off excess and smeared adhesive while wet.

H. Apply temporary battens over surface of treated plaster to prevent further separation during repair work. Secure battens in place against plaster with screws through the battens and plaster and into the wood lath. Shoring design is the responsibility of the contractor – provide additional shoring as needed to secure plaster during work.

I. Maintain temporary battens in place for a week or more, allowing adhesive to coalesce and dry.

J. Remove battens, patch holes and missing plaster, and repair cracks.

3.12 INSTALLATION TOLERANCES

A. Completed plaster installation shall not deviate from a true plane by more than 1/8 inch (3 mm) as measured by a 5-foot (1.5-m) straightedge placed at any location on a surface, except where existing plaster is retained as a substrate for new plasterwork.

3.13 CLEANING AND PROTECTION

A. Protect work of other trades against damage. Promptly remove plaster from surfaces not indicated to be repaired or plastered. Do not scratch or damage finished surfaces.

B. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

C. Correct damage to other historic surfaces and to new work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. Remove temporary protection and enclosure of other work.

END OF SECTION 09 03 20
SECTION 09 03 91 - HISTORIC TREATMENT OF PLAIN PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes historic treatment of plain painting as follows:

1. Removing existing paint.
2. Repairing substrates.
3. Preparation of historic surfaces.

B. Related Requirements:

1. Section 02 82 33 Removal and Disposal of Asbestos Containing Materials related to substrates containing ACM
2. Section 02 83 19.13 Lead Based Paint Removal and Disposal
3. Section 02 86 00 Other Hazardous Materials Abatement
4. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
5. Section 09 90 00 for Painting

1.3 DEFINITIONS

A. Historic Paint Materials: Paint materials manufactured to match historic paint formulations; either custom-formulated products or standard products of manufacturers of historic paint materials.

B. Modern Paint Materials: Paint materials not designed to match historic paint formulations but that may be required to match historic paint colors.

C. Plain Painting: For historic treatment, this means painting that requires attention to historic treatment requirements, but no special, decorative or artistic painting skill.

D. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

E. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of painting.

2. Review methods and procedures related to historic treatment of painting including, but not limited to, the following:
   
   a. Verify historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
   
   b. Materials, material application, colors, patterns, and sequencing.
   
   c. Fire-protection plan.
   
   d. Plain painting historic treatment program.
   
   e. Coordination with building occupants.

1.5 SEQUENCING AND SCHEDULING

   A. Perform historic treatment of painting in the following sequence, which includes work specified in this and other Sections:

      1. Dismantle existing surface-mounted objects and hardware except items indicated to remain in place. Tag items with location identification and protect.
      2. Verify that temporary protections have been installed.
      3. Examine condition of surfaces to be painted.
      4. Remove existing paint to the degree required for each substrate and surface condition of existing paint.
      5. Apply paint system.
      6. Reinstall dismantled surface-mounted objects and hardware unless otherwise indicated.

1.6 ACTION SUBMITTALS

   A. Product Data: For each type of product.

      1. Include recommendations for product application and use. Include test data substantiating that products comply with requirements.

   B. Product List: For each paint product indicated, include the following:

      1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.7 INFORMATIONAL SUBMITTALS

   A. Qualification Data: For paint-remover manufacturer.

   B. Preconstruction Test Reports: For cleaning materials, paint removers and paint coatings and systems.
1.8 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic painting specialist with expertise in matching and touching up existing painting. Experience only in new painting work is insufficient experience for historic treatment work.

B. Paint-Remover Manufacturer Qualifications: A firm regularly engaged in producing paint removers that have been used for similar historic painting applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection and on-site assistance.

C. Plain Painting Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for historic treatment work, including protection of surrounding materials and Project site and control of runoff during cleaning, paint removal, repainting, and other processes.

   1. If materials and methods other than those indicated are proposed for any phase of historic treatment work, add a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.

D. Mockups: Prepare mockups of historic treatment processes for each type of coating system and substrate indicated and each color and finish required to demonstrate aesthetic effects and to set quality standards for materials and execution. Duplicate appearance of approved Sample submittals.

   1. Locate mockups in locations that enable viewing under same conditions as the completed Work.
   2. Surface-Preparation Mockups: On existing surfaces using applicable specified methods of cleaning and other surface preparation, provide mockup sample of at least 100 sq. ft. (9 sq. m).
   3. Coating Mockups: Two wall surfaces of at least 100 sq. ft. (9 sq. m) to represent surfaces and conditions for application of each type of coating system under same conditions as the completed Work.

      a. Plain painted surfaces.

   4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified historic treatment specialist to perform preconstruction testing of cleaning materials, paint removers and compatibility of paint coatings and systems for each type of historic painted surface.

   1. Use test areas as indicated and representative of proposed materials and existing construction.
   2. Propose changes to materials and methods to suit Project.
1.10 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste daily.

1.11 FIELD CONDITIONS

A. Concealed and undocumented historic items, murals, and similar objects encountered during historic treatment remain Owner's property. Carefully protect each item or object.

PART 2 - PRODUCTS

2.1 PREPARATORY CLEANING MATERIALS

A. Water: Potable.
B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).
C. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for every 5 gal. (20 L) of solution required.
D. Mildewcide: Commercial proprietary mildewcide or a job-mixed solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.
E. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.
F. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.2 PAINT REMOVERS

A. Alkaline Paste Paint Remover: Manufacturer's standard alkaline paste or gel formulation for removing paint from masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methylene chloride.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. American Building Restoration Products, Inc.
   b. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
   c. PROSOCO, Inc.
B. Covered or Skin-Forming Alkaline Paint Remover: Manufacturer's standard covered or skin-forming alkaline paste or gel formulation for removing paint from masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methylene chloride.

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   
a. [American Building Restoration Products, Inc.](#)  
b. [Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.](#)  
c. [Dumond Chemicals, Inc.](#)  

C. Solvent-Type Paste Paint Remover: Manufacturer's standard water-rinsable, solvent-type paste or gel formulation for removing paint from masonry, stone, wood, plaster, or metal as required to suit Project.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   
a. [Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.](#)  
b. [Hydroclean; Hydrochemical Techniques, Inc.](#)  
c. [PROSOCO, Inc.](#)  
d. [Shore Corporation.](#)  

D. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methanol or methylene chloride.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   
a. [American Building Restoration Products, Inc.](#)  
b. [Cathedral Stone Products, Inc.](#)  
c. [Dumond Chemicals, Inc.](#)  
d. [EaCo Chem, Inc.](#)  
e. [PROSOCO, Inc.](#)  

E. Covered, Solvent-Type Paste Paint Remover: Manufacturer's standard, low-odor, covered, water-rinsable, solvent-type paste or gel formulation for removing paint from masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methanol or methylene chloride.

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   
a. [Dumond Chemicals, Inc.](#)  
b. [PROSOCO, Inc.](#)  

2.3 PAINT, GENERAL

A. Refer to Section 09 90 00 Painting.
2.4 PATCHING MATERIALS

A. Wood-Patching Compound: Two-part, epoxy-resin, wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound shall be capable of filling deep holes and spreading to feather edge.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   
   a. Abatron, Inc.
   b. Advanced Repair Technology, Inc.
   c. ConServ Epoxy LLC.
   d. Gougeon Brothers, Inc.
   e. Polymeric Systems, Inc.
   f. Protective Coating Company.
   g. System Three Resins, Inc.

B. Metal Patching Compound: Two-part, polyester-resin, metal patching compound; knife-grade formulation as recommended in writing by manufacturer for type of metal repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be produced for filling metal that has deteriorated due to corrosion. Filler shall be capable of filling deep holes and spreading to feather edge.

C. Cementitious Patching Compounds: Cementitious patching compounds and repair materials specifically manufactured for filling cementitious substrates and for sanding or tooling prior to repainting; formulation as recommended in writing by manufacturer for type of cementitious substrate indicated, exposure to weather and traffic, the detail of work, and site conditions.

D. Gypsum-Plaster Patching Compound: Finish coat plaster and bonding compound according to ASTM C 842 and manufacturer's written instructions.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT SPECIALIST

3.2 PROTECTION

A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist chemical solutions being used unless the solutions will not damage adjacent surfaces. Use protective materials that are UV resistant and waterproof. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.

2. Do not apply chemical solutions during winds of sufficient force to spread them to unprotected surfaces.
3. Neutralize and collect alkaline and acid wastes before disposal.
4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

3.3 HISTORIC TREATMENT OF PAINTING, GENERAL

A. Historic Treatment Appearance Standard: Completed work is to have a uniform appearance as viewed by Architect from building interior at 5 feet (1.5 m) away from painted surface and from building exterior at 20 feet (6 m) away from painted surface.

B. Execution of the Work: In treating historic items, disturb them as minimally as possible and as follows:

1. Remove failed coatings and corrosion and repaint.
2. Verify that substrate surface conditions are suitable for painting.
3. Allow other trades to repair items in place and retain as much original material as possible before repainting.
4. Reproduce original, historic paint systems where indicated or scheduled.
5. Install temporary protective measures to protect historic painted surfaces that shall be treated later.

C. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use only the gentlest mechanical methods, such as scraping and lightly hand sanding, that will not abrade softer substrates, reducing clarity of detail. Do not use abrasive methods such as rotary sanding, rotary wire brushing, or power tools except as indicated as part of the historic treatment program and as approved by Architect.

D. Heat Processes: Do not use torches, heat guns, or heat plates.

3.4 EXAMINATION

1. Refer to Section 09 90 00 Painting

3.5 PREPARATORY CLEANING

A. General: Use only the gentlest, appropriate method necessary to clean surfaces in preparation for painting. Clean all surfaces, corners, contours, and interstices.

B. Detergent Cleaning: Wash surfaces by hand using clean rags, sponges, and bristle brushes. Scrub surface with detergent solution and bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet. Rinse with water applied by clean rags or sponges.

C. Solvent Cleaning: Use solvent cleaning to remove oil, grease, smoke, tar, and asphalt from painted or unpainted surfaces before other preparation work. Wipe surfaces with solvent using clean rags and sponges. If necessary, spot-solvent cleaning may be employed just prior to commencement of paint application, provided enough time is allowed for complete evaporation. Use clean solvent and clean rags for the final wash to ensure that all foreign materials have been removed. Do not use solvents, including primer thinner and turpentine, that leave residue.
D. Mildew: Clean off existing mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. Rinse with water applied by clean rags or sponges.

E. Chemical Rust Removal:
   1. Remove loose rust scale with approved abrasives for ferrous-metal cleaning.
   2. Apply rust remover with brushes or as recommended in writing by manufacturer.
   3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing. Do not allow extended dwell time.
   4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
   5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
   6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

F. Mechanical Rust Removal:
   1. Remove rust with approved abrasives for ferrous-metal cleaning. Clean to bright metal.
   2. Wipe off residue with mineral spirits and either steel wool or soft rags.
   3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
   4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.6 PAINT REMOVAL

A. General: Remove paint where indicated. Where cleaning methods have been attempted and further removal of the paint is required because of incompatible or unsatisfactory surfaces for repainting, remove paint to extent required by conditions.

   1. Application: Apply paint removers according to paint-remover manufacturer’s written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
      a. Apply materials to all surfaces, corners, contours, and interstices, to provide a uniform final appearance without streaks.
      b. After work is complete, remove protection no longer required. Remove tape and adhesive marks.

   2. Brushes: Use brushes that are resistant to chemicals being used.
      a. Metal Substrates: If using wire brushes on metal, use brushes of same metal composition as metal being treated.
      b. Wood Substrates: Do not use wire brushes.

   3. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.
      a. Equip units with pressure gages.
b. Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from surface and apply material in horizontal, back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

c. For chemical spray application, use low-pressure tank or chemical pump suitable for chemical indicated, equipped with nozzle having a cone-shaped spray.

d. For water-spray application, use fan-shaped spray tip that disperses water at an angle of 25 to 50 degrees.

e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.

B. Paint Removal with Hand Tools: Remove paint manually using hand-held scrapers, wire brushes, sandpaper, and metallic wool as appropriate for the substrate material. Do not use other methods except as indicated as part of the historic treatment program and as approved by Architect.

C. Paint Removal with Alkaline Paste Paint Remover:

1. Remove loose and peeling paint using scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with brushes.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. At masonry substrates only, rinse with cold water applied by medium-pressure spray to remove chemicals and paint residue.
5. At all other substrates, use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
6. Repeat process if necessary to remove all paint.

D. Paint Removal with Covered or Skin-Forming Alkaline Paint Remover:

1. Remove loose and peeling paint using scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to dry, painted surface with natural-fiber cleaning brush, deep-nap roller, or large paintbrush. Apply in one or two coats according to manufacturer's written instructions.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with hot water applied by medium-pressure spray to remove chemicals and paint residue.
7. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
8. For spots of remaining paint, apply alkaline paste paint remover according to “Paint Removal with Alkaline Paste Paint Remover” Paragraph.

E. Paint Removal with Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to dry, painted surface with natural-fiber cleaning brush, deep-nap roller, or large paintbrush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Rinse with hot water applied by medium-pressure spray to remove chemicals and paint residue.
5. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
6. Repeat process if necessary to remove all paint.

F. Paint Removal with Covered, Solvent-Type Paste Paint Remover:
1. Remove loose and peeling paint using scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with natural-fiber cleaning brush, deep-nap roller, or large paint brush or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with hot water applied by medium-pressure spray to remove chemicals and paint residue.
7. Use mechanical methods recommended in writing by manufacturer to remove remaining chemicals and paint residue.

3.7 SUBSTRATE REPAIR

A. General: Repair substrate surface defects that are inconsistent with the surface appearance of adjacent materials and finishes.

B. Wood Substrate:
1. Repair wood defects including dents and gouges more than 1/8 inch (3 mm) in size and all holes and cracks by filling with wood-patching compound and sanding smooth. Reset or remove protruding fasteners.
2. Where existing paint is allowed to remain, sand irregular buildup of paint, runs, and sags to achieve a uniformly smooth surface.

C. Cementitious Material Substrate:
1. General: Repair defects including dents and chips more than 1/4 inch (6 mm) in size and all holes and cracks by filling with cementitious patching compound and sanding smooth. Remove protruding fasteners.
2. New and Bare Plaster: Neutralize surface of plaster with mild acid solution as recommended in writing by paint manufacturer. In lieu of acid neutralization, follow manufacturer's written instruction for primer or transition coat over alkaline plaster surfaces.
3. Concrete, Cement Plaster, and Other Cementitious Products: Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. If surfaces are too alkaline to paint, correct this condition before painting.

D. Gypsum-Plaster and Gypsum-Board Substrates:
1. Repair defects including dents and chips more than 1/8 inch (3 mm) in size and all holes and cracks by filling with gypsum-plaster patching compound and sanding smooth. Remove protruding fasteners.

2. Rout out surface cracks to remove loose, unsound material; fill with patching compound and sand smooth.

E. Metal Substrate:

1. Preparation: Treat repair locations by wire-brushing and solvent cleaning. Use mechanical rust removal method to clean off rust.

2. Defects in Metal Surfaces: Repair non-load-bearing defects in existing metal surfaces, including dents and gouges more than 1/16 inch (6 mm) deep or 1 inch (25 mm) across and all holes and cracks by filling with metal patching compound and sanding smooth. Remove burrs and protruding fasteners.

3. Priming: Prime iron and steel surfaces immediately after repair to prevent flash rusting. Stripe paint corners, crevices, bolts, welds, and sharp edges. Apply two coats to surfaces that are inaccessible after completion of the Work.

3.8 PAINT APPLICATION, GENERAL

A. Comply with manufacturers’ written instructions for application methods unless otherwise indicated in this Section.

B. Prepare surfaces to be painted according to the Surface-Preparation Schedule and with manufacturer's written instructions for each substrate condition.

C. Apply a transition coat over incompatible existing coatings.

D. Metal Substrate: Stripe paint corners, crevices, bolts, welds, and sharp edges before applying full coat. Apply two coats to surfaces that are inaccessible after completion of the Work. Tint stripe coat different than the main coating and apply with brush.

E. Blending Plain Painted Surfaces: When painting new substrates patched into existing surfaces or touching up missing or damaged finishes, apply coating system specified for the specific substrate. Apply final finish coat over entire surface from edge to edge and corner to corner.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a testing agency to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

B. Notify testing agency in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until testing agency has had reasonable opportunity to inspect work areas at lift device or scaffold location.

C. Manufacturer's Field Service: Engage paint-remover manufacturer's factory-authorized service representative for consultation and Project-site inspection, and provide on-site assistance when requested by Architect.
3.10 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.11 SURFACE-PREPARATION SCHEDULE

A. General: Before painting, prepare surfaces for painting according to applicable requirements specified in this schedule.

1. Examine surfaces to evaluate each surface condition according to paragraphs below.
2. Where existing degree of soiling prevents examination, preclean surface and allow it to dry before making an evaluation.
3. Repair substrate defects according to "Substrate Repair" Article.

B. Surface Preparation for MPI DSD 0 Degree of Surface Degradation:

1. Surface Condition: Existing paint film in good condition and tightly adhered.
2. Paint Removal: Not required.
3. Preparation for Painting: Wash surface by detergent cleaning; use solvent cleaning where needed. Roughen or degloss cleaned surfaces to ensure paint adhesion according to paint manufacturer's written instructions.

C. Surface Preparation for MPI DSD 1 Degree of Surface Degradation:

1. Surface Condition: Paint film cracked or broken but adhered.
2. Paint Removal: Scrape by hand-tool cleaning methods to remove loose paint until only tightly adhered paint remains.
3. Preparation for Painting: Wash surface by detergent cleaning; use other cleaning methods for small areas of bare substrate if required. Roughen, degloss, and sand the cleaned surfaces to ensure paint adhesion and a smooth finish according to paint manufacturer's written instructions.

D. Surface Preparation for MPI DSD 2 Degree of Surface Degradation:

1. Surface Condition: Paint film loose, flaking, or peeling.
2. Paint Removal: Remove loose, flaking, or peeling paint film by hand-tool or chemical paint-removal methods.
3. Preparation for Painting: Wash surface by detergent cleaning; use solvent cleaning where needed. Use other cleaning methods for small areas of bare substrate if required. Sand surfaces to smooth
remaining paint film edges. Prepare bare cleaned surface to be painted according to paint manufacturer's written instructions for substrate construction materials.

E. Surface Preparation for MPI DSD 3 Degree of Surface Degradation:

1. Surface Condition: Paint film severely deteriorated and surface indicated to have paint completely removed.
3. Preparation for Painting: Prepare bare cleaned surface according to paint manufacturer's written instructions for substrate construction materials.

F. Surface Preparation for MPI DSD 4 Degree of Surface Degradation:

1. Surface Condition: Missing material, small holes and openings, and deteriorated or corroded substrate.
2. Substrate Preparation: Repair, replace, and treat substrate according to "Substrate Repair" Article and requirements in other Specification Sections.
3. Preparation for Painting: Sand substrate surfaces to smooth remaining paint film edges and prepare according to paint manufacturer's written instructions for substrate construction materials. Remove rust.
4. Painting: Paint as required for MPI DSD 2 degree of surface degradation.

3.12 EXISTING AND HISTORIC MATERIAL PAINTING PREPARATION

A. General:
1. For MPI DSD 1 degree of surface degradation, touch up with topcoat.
2. For MPI DSD 2 degree of surface degradation, spot prime with Primer,
3. For MPI DSD 3 degree of surface degradation, fully prime coat with Primer,
4. Where existing substrate is not compatible, provide bonding/bridging coating.

END OF SECTION 09 03 91
SECTION 09 21 16.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section includes gypsum board shaft wall assemblies.

1.3 ACTION SUBMITTALS
A. Product Data: For each component of gypsum board shaft wall assembly.
B. Sustainable Design Submittals:
   1. **Product Data**: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
   2. **Product Certificates**: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.

1.4 DELIVERY, STORAGE, AND HANDLING
A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and support them on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS
A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.
B. Do not install finish panels until installation areas are enclosed and conditioned.
C. Do not install panels that are wet, moisture damaged, or mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.

C. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

D. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

E. Regional Materials: Products shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

A. Fire-Resistance Rating: As indicated.

B. STC Rating: As indicated.

C. Gypsum Shaftliner Board:

1. Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, 1 inch (25.4 mm) thick, with double beveled long edges.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) American Gypsum.
      2) National Gypsum Company.
      3) Temple-Inland Building Products by Georgia-Pacific.
      4) United States Gypsum Company.

2. Moisture- and Mold-Resistant Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with ASTM D 3273 mold-resistance score of 10 as rated according to ASTM D 3274, 1 inch (25.4 mm) thick, and with double beveled long edges.
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      1) American Gypsum.
      2) National Gypsum Company.
      3) Temple-Inland Building Products by Georgia-Pacific.
      4) United States Gypsum Company.
3. Moisture- and Mold-Resistant, Fiberglass-Mat Faced: ASTM C 1658/C 1658M; manufacturer's proprietary fire-resistive liner panels with ASTM D 3273 mold-resistance score of 10 as rated according to ASTM D 3274, 1 inch (25.4 mm) thick, and with double beveled long edges.
   a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
      1) American Gypsum.
      2) Georgia-Pacific Building Products.
      3) United States Gypsum Company.

D. Non-Load-Bearing Steel Framing, General: Complying with ASTM C 645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.
   1. Protective Coating: ASTM A 653/A 653M, G60 (60), hot-dip galvanized unless otherwise indicated.

E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:
   1. Depth: As indicated.
   2. Minimum Base-Metal Thickness: as required to comply with UL Fire Resistance Rating Assembly and manufacturer span requirements for thickness listed.

F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches (51 mm) long and matching studs in depth.
   1. Minimum Base-Metal Thickness: Matching steel studs.

G. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
   1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Blazeframe Industries.
      b. CEMCO; California Expanded Metal Products Co.
      c. Fire Trak Corp.
      d. Grace Construction Products; W.R. Grace & Co. -- Conn.
      e. Metal-Lite.

H. Elevator-Hoistway-Entrance Struts: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches (76 mm), matching studs in depth, and not less than 0.033 inch (0.84 mm) thick.

I. Finish Panels: As indicated.

J. Sound Attenuation Blankets: As specified in Section 07 21 16 “Batts and Blankets”

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.
B.  Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.

C.  Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

D.  Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

   1.  Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.

   2.  Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

E.  Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch (0.84-mm) minimum thickness of base metal (uncoated).

F.  Acoustical Sealant: Section 079219 "Acoustical Joint Sealants."

G.  Gypsum Board Cants:

   1.  Gypsum Board Panels: As specified in Section 092900 "Gypsum Board," Type X, 5/8-inch (13- or 16-mm) panels.

   2.  Adhesive: Laminating adhesive as specified in Section 092900 "Gypsum Board."

   3.  Non-Load-Bearing Steel Framing: As specified in Section 092216 "Non-Structural Metal Framing."

PART 3 - EXECUTION

3.1  EXAMINATION

A.  Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B.  Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C.  Proceed with installation only after unsatisfactory conditions have been corrected.

3.2  INSTALLATION

A.  General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.

B.  Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.

1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
2. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.

D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.

E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.

F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

G. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.

H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.

I. Gypsum Board Cants: At projections into shaft exceeding 4 inches (102 mm), install gypsum board cants covering tops of projections.

1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches (610 mm) o.c. with screws fastened to shaft wall framing.
2. Where non-load-bearing steel framing is required to support gypsum board cants, install framing at 24 inches (610 mm) o.c. and extend studs from the projection to shaft wall framing.

J. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.3 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
END OF SECTION 09 21 16.23
SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Non-load-bearing steel framing systems for interior partitions.
   2. Suspension systems for interior ceilings and soffits.
   3. Grid suspension systems for gypsum board ceilings.
   4. Resilient sound isolation clips.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Studs and Runners: Provide documentation that framing members' certification is according to SIFA's "Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members."
   2. Resilient sound isolation clips.

B. Sustainable Design Submittals:
   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For embossed steel studs and runners and firestop tracks, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft. (239 Pa). Deflection shall be limited to 1/600 at walls with tile finishes.

2.2 FRAMING SYSTEMS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.


C. Studs and Runners: ASTM C 645. Use either steel studs and runners or embossed steel studs and runners.

1. Steel Studs and Runners:

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

      1) CEMCO; California Expanded Metal Products Co.
      2) MBA Building Supplies.
      3) MRI Steel Framing, LLC.
      4) Phillips Manufacturing Co.
      5) Steel Network, Inc. (The).

   b. Minimum Base-Metal Thickness: As required by performance requirements for horizontal deflection and fire rated assembly where applicable.

   c. Gauge of Studs shall meet requirements of TCNA assemblies where used in walls with tile finish – minimum 20 gauge.

   d. Depth: As indicated on Drawings.

2. Embossed Steel Studs and Runners:
a. **Manufacturers**: Subject to compliance with requirements, provide products by one of the following:

1) CEMCO; California Expanded Metal Products Co.
2) ClarkDietrich Building Systems.
3) MarinoWARE.
4) MBA Building Supplies.
5) Phillips Manufacturing Co.
6) Steel Network, Inc. (The).

b. **Minimum Base-Metal Thickness**: As required by performance requirements for horizontal deflection and fire rated assembly where applicable.

c. **Gauge of Studs**: shall meet requirements of TCNA assemblies where used in walls with tile finish – minimum 20 gauge.

d. **Depth**: As indicated on Drawings.

D. **Slip-Type Head Joints**: Where indicated, provide the following:

1. **Deflection Track**: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

   a. **Manufacturers**: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   1) Blazeframe Industries.
   2) CEMCO; California Expanded Metal Products Co.
   3) ClarkDietrich Building Systems.
   4) MBA Building Supplies.
   5) Metal-Lite.
   6) Perfect Wall, Inc.
   7) Steel Network, Inc. (The).

E. **Firestop Tracks**: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. **Manufacturers**: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Blazeframe Industries.
   b. CEMCO; California Expanded Metal Products Co.
   c. ClarkDietrich Building Systems.
   d. Fire Trak Corp.
   e. Metal-Lite.
   f. Perfect Wall, Inc.

F. **Flat Strap and Backing Plate**: Steel sheet for blocking and bracing in length and width indicated.
1. Same manufacturer as main framing components.

2. Minimum Base-Metal Thickness: 0.0329 inch (0.836 mm).

G. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
   1. Same manufacturer as main framing components.
   2. Depth: 1-1/2 inches (38 mm).
   3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
   1. Minimum Base-Metal Thickness: 0.0179 inch (0.455 mm).
   2. Depth: As indicated on Drawings.

I. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.

J. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
   1. Depth: As indicated on Drawings.
   2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch (0.8 mm).
   3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.0179 inch (0.455 mm), and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:
   1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.
   2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
D. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated.

E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
   1. Depth: 2-1/2 inches (64 mm).

F. Furring Channels (Furring Members):
   1. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
      a. Minimum Base-Metal Thickness: 0.0179 inch (0.455 mm).
   2. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.

G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Armstrong World Industries, Inc.
      b. Chicago Metallic Corporation.
      c. United States Gypsum Company.

H. Resilient Sound Isolation Clips
   1. Basis-of-Design Product: Subject to compliance with requirements, provide PAC International, LLC., Las Vegas, NV 89131. Toll Free (866) RSIC-100 (866) 774-2100. Phone (503) 649-7700. Fax (503) 649-2710. Web Site www.pac-intl.com. E-Mail info@pac-intl.com.; RSIC-1ADM or a comparable product by one of the following:
      a. Kinetic Noise Control, Dublin, Ohio.
      b. Embelton Noise and Vibration Isolation.
   2. Rubber Isolator:
      a. Natural and Manufactured rubber compound.
      b. Molded to isolate ferrule from clip.
      c. Minimum of 12 micro-vibration controlling pedestals at point of contact with framing member.
      d. Manufactured to ASTM D 2000, M2 AA 510 A13, which includes:
         1) Hardness, ASTM D 2240, Shore A: 47.
         2) Modulus 300 Percent, ASTM D 412, Die C: 5.3 MPa.
         3) Tensile Strength, ASTM D 412, Die C: 11.2MPa.
         4) Elongation at Break, ASTM D 573: 454 percent.
   3. Clip: Galvanized or aluminum-zinc coated steel, 16 gauge.
   5. Projection: 4" inches from supporting structure, when 7/8-inch drywall furring channels are used.
2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Basement Walls: Provide the following:

2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

C. Acoustical Sealant: Flexible, non-hardening. As specified in Section 07 92 19.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (610 mm) o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.
3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: As required by horizontal deflection performance requirements 16 inches (406 mm) o.c. unless otherwise indicated.
2. Multilayer Application: As required by horizontal deflection performance requirements 16 inches (406 mm) o.c. unless otherwise indicated.
3. Tile Backing Panels: As required by horizontal deflection performance requirements 16 inches (406 mm) o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
   a. Install two studs at each jamb unless otherwise indicated.
b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.

c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

   a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

6. Curved Partitions:

   a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.

   b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.

E. Direct Furring:

   1. Screw to wood framing.

   2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Z-Shaped Furring Members:

   1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches (610 mm) o.c.

   2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

   3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

   1. Hangers: 48 inches (1219 mm) o.c.
2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
      a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
      a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
   3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   5. Do not attach hangers to steel roof deck.
   6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
   7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
   8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.6 INSTALLING RESILIENT SOUND ISOLATION CLIPS

A. Install resilient sound isolation clips and drywall furring channels in accordance with manufacturer's instructions.
B. Mechanically fasten resilient sound isolation clips to structure with screws, bolts, or expansion anchors, dependent upon structure.

C. Fire-Resistive Design Assemblies:
1. Install as specified in UL Fire Resistance Directory, where required.
2. Do not arbitrarily add resilient sound isolation clips to fire-rated assemblies.

D. Space resilient sound isolation clips at maximum of 24 inches (600mm) by 48 inches (1,200 mm) on center.

E. Do not exceed design load (pull and shear) of 36 pounds per isolation clip.

F. Stagger isolation clip installation, so dead load is supported by all support members.

G. Splicing Drywall Furring Channels:
1. Splice drywall furring channels with minimum of 6-inch laps.
2. Secure laps with 2 framing screws or 18 gauge tie wire double wrapped.
3. Locate splices between resilient sound isolation clips.
4. Do no locate splices on resilient sound isolation clips.

H. Install resilient sound isolation clips on 1 side of wall assembly, unless otherwise indicated on the drawings.

I. Flanking Noise:
1. Review installation details to prevent structure-borne flanking noise.
2. Do not allow drywall furring channels or gypsum board to contact foreign materials, including floors, ceilings, or wall framing members.

J. Ensure metal ferrule of resilient sound isolation clips is in firm contact with structural member.

K. Gypsum Board:
1. Install gypsum board in vertical or horizontal position with 1/8-inch to ¼-inch gap around perimeter for acoustical sealant application.
2. Install gypsum board in accordance with ASTM C 840 as specified in Section 09 29 00.

L. Acoustical Sealant:
1. Seal potential air leaks with acoustical sealant to achieve best Field Sound Transmission Class (FSTC).
2. Seal electrical outlets and penetrations with acoustical sealant.
3. Apply fire-rated acoustical sealant at locations where fire-rated assembly is required.

M. Install drywall furring channels perpendicular, parallel, or angular to framing members.

N. Space Drywall Furring Channels:
1. Maximum of 16 inches on center with:
   a. Double layer of 5/8-inch gypsum board.
2. Reduce spacing of drywall furring channels to prevent potential for sagging of gypsum board or when additional loads are supported by resilient sound isolation clips.

O. Locate resilient sound isolation clips maximum of 8 inches from ends of drywall furring channels.
P. Locate drywall furring channels maximum of 3 inches from parallel wall assemblies.

END OF SECTION 09 22 16
SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section Includes:
      1. Interior gypsum board.
      2. Exterior gypsum board for ceilings and soffits.
      3. Tile backing panels.
      4. Texture finishes.
   B. Related Requirements:
      1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
      2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
      3. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
      4. Section 092613 "Gypsum Veneer Plastering" for gypsum base for veneer plaster and for other components of gypsum-veneer-plaster finishes.
      5. Section 093013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Sustainable Design Submittals:
      1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
      2. Product Data: For adhesives and sealants, indicating VOC content.
      3. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.
      4. Laboratory Test Reports: For ceiling and wall materials, indicating compliance with requirements for low-emitting materials.
   C. Samples: For the following products:
1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

D. Samples for Initial Selection: For each type of trim accessory indicated.

E. Samples for Verification: For the following products:
   1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE

A. Mockups: Build mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.

   1. Build mockups for the following:
      a. Each level of gypsum board finish indicated for use in exposed locations.
      b. Each texture finish indicated.

   2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.

   3. Simulate finished lighting conditions for review of mockups.

   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Ceiling and wall materials shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 GYPSUM BOARD, GENERAL

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 5 percent.

B. Regional Materials: Products shall be manufactured within 500 miles (160 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (160 km) of Project site.

C. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. American Gypsum.
   b. CertainTeed Corporation.
   c. Continental Building Products, LLC.
   d. Georgia-Pacific Building Products.
   e. National Gypsum Company.
   f. Temple-Inland Building Products by Georgia-Pacific.

2. Thickness: 5/8 inch (15.9 mm).

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
2. Thickness: 5/8 inch (15.9 mm).

C. Flexible Gypsum Board: ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.
   1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. American Gypsum.
      b. CertainTeed Corporation.
      c. Continental Building Products, LLC.
      d. Georgia-Pacific Building Products.
      e. National Gypsum Company.
      f. Temple-Inland Building Products by Georgia-Pacific.
   2. Thickness: 1/4 inch (6.4 mm).

D. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
   1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. American Gypsum.
      b. CertainTeed Corporation.
      c. Continental Building Products, LLC.
      d. Georgia-Pacific Building Products.
      e. National Gypsum Company.
      f. Temple-Inland Building Products by Georgia-Pacific.
   2. Core: 5/8 inch (15.9 mm), Type X.
   4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 SPECIALTY GYPSUM BOARD

A. Gypsum Board, Type C: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability.
1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. [American Gypsum](#).
   b. [CertainTeed Corporation](#).
   c. [Continental Building Products, LLC](#).
   d. [Georgia-Pacific Building Products](#).
   e. [National Gypsum Company](#).
   f. [Temple-Inland Building Products by Georgia-Pacific](#).

2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.

**B.** Glass-Mat Interior Gypsum Board: ASTM C 1658/C 1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. [Continental Building Products, LLC](#).
   b. [Georgia-Pacific Building Products](#).
   c. [National Gypsum Company](#).
   d. [Temple-Inland Building Products by Georgia-Pacific](#).

2. Core: **5/8 inch (15.9 mm), Type X.**
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

**C.** Acoustically Enhanced Gypsum Board: ASTM C 1396/C 1396M. Multilayer products constructed of two layers of gypsum boards sandwiching a viscoelastic sound-absorbing polymer core.

1. Core: **5/8 inch (15.9 mm), Type X.**
2. Long Edges: Tapered.

2.5 **TILE BACKING PANELS**

**A.** Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, with manufacturer's standard edges.

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. [C-Cure](#).
   b. [CertainTeed Corporation](#).
   c. [Custom Building Products](#).
   d. [FinPan, Inc](#).
   e. [James Hardie Building Products, Inc](#).
   f. [National Gypsum Company](#).
2. Thickness: 5/8 inch (15.9 mm).

3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

B. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Gypsum.
   b. CertainTeed Corporation.
   c. Georgia-Pacific Building Products.
   d. United States Gypsum Company.

2. Core: 5/8 inch (15.9 mm), Type X.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.

2. Shapes:
   a. Cornerbead.
   b. Bullnose bead.
   c. LC-Bead: J-shaped; exposed long flange receives joint compound.
   d. L-Bead: L-shaped; exposed long flange receives joint compound.
   e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
   f. Expansion (control) joint.
   g. Curved-Edge Cornerbead: With notched or flexible flanges.


1. Material: Hot-dip galvanized-steel sheet, plastic, or rolled zinc.

2. Shapes:
   a. Cornerbead.
   b. LC-Bead: J-shaped; exposed long flange receives joint compound.
   c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Fry Reglet Corporation.
   b. Gordon, Inc.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.

3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
   a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

D. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.
3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.8 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Adhesives shall have a VOC content of 50 g/L or less.
2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of
Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
   1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
   2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
   1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
   2. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 5 percent.

E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
   1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
      a. Accumetric LLC.
      b. Franklin International.
      c. Grabber Construction Products.
      d. Hilti, Inc.
      e. Pecora Corporation.
      f. Specified Technologies, Inc.
      g. United States Gypsum Company.

F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

G. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

**PART 3 - EXECUTION**

3.1 **EXAMINATION**

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
   2. Fit gypsum panels around ducts, pipes, and conduits.
   3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.
3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: As indicated on Drawings Vertical surfaces unless otherwise indicated.
2. Type X: As indicated on Drawings and where required for fire-resistance-rated assembly.
3. Flexible Type: Apply in double layer at curved assemblies.
4. Ceiling Type: Ceiling surfaces.
5. Mold-Resistant Type: At all basement walls.
6. Water-Resistant Gypsum Board: Toilets, Pot Washing, Janitor’s Closet, Mechanical Rooms, and other wet and high humidity areas indicated on Drawings. Within 10 feet of all plumbing fixtures.
7. Type C: Where required for specific fire-resistance-rated assembly indicated.
8. Glass-Mat Interior Type: As indicated on Drawings.
9. Acoustically Enhanced Type: In “acoustical” type partitions on “dry” side.
10. Skim-Coated Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
   a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
   b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer’s written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.
E. Curved Surfaces:
   1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
   2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS
   A. Apply panels perpendicular to supports, with end joints staggered and located over supports.
      1. Install with 1/4-inch (6.4-mm) open space where panels abut other construction or structural penetrations.
      2. Fasten with corrosion-resistant screws.

3.5 APPLYING TILE BACKING PANELS
   A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.
   B. Water-Resistant Backing Board: Install where indicated with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
   C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.6 INSTALLING TRIM ACCESSORIES
   A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
   B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
   C. Interior Trim: Install in the following locations:
      1. Cornerbead: Use at outside corners unless otherwise indicated.
      2. L-Bead: Use where indicated.
      3. U-Bead: Use at exposed panel edges.
   D. Exterior Trim: Install in the following locations:
      1. Cornerbead: Use at outside corners.
      2. LC-Bead: Use at exposed panel edges.
   E. Aluminum Trim: Install in locations indicated on Drawings.
3.7 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 3: not used.
4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
   a. Primer and its application to surfaces are specified in Section 099000 – Painting.

5. Level 5: Where indicated on drawings / finish schedule.
   a. Primer and its application to surfaces are specified in Section 099000 – Painting.

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer’s written instructions for use as exposed soffit board.

F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

G. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.8 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00
SECTION 09 30 13 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Ceramic mosaic tile.
   2. Porcelain tile.
   3. Glazed wall tile.
   5. Waterproof membrane for thinset applications.
   6. Crack isolation membrane.
   7. Metal edge strips.

B. Related Requirements:
   1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
   2. Section 092900 "Gypsum Board" for cementitious backer units.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.


C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.
1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. [Double click to insert sustainable design text for adhesives.]
   2. [Double click to insert sustainable design text for low-emitting sealers.]

C. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

D. Samples for Initial Selection: For tile, grout, and accessories involving color selection.

E. Samples for Verification:
   1. Full-size units of each type and composition of tile and for each color and finish required.
   2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches (300 mm) square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
   3. Full-size units of each type of trim and accessory for each color and finish required.
   4. Stone thresholds in 6-inch (150-mm) lengths.
   5. Metal edge strips in 6-inch (150-mm) lengths.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product.

D. Product Test Reports: For tile-setting and -grouting products and certified porcelain tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
   2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
3. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
2. Obtain waterproof membrane and crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Stone thresholds.
2. Waterproof membrane.
3. Crack isolation membrane.
4. Cementitious backer units.
5. Metal edge strips.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

2.3 TILE PRODUCTS

1. See finish schedule for basis of design tile types.

2.4 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.

B. Marble Thresholds: ASTM C 503/C 503M, with a minimum abrasion resistance of 10 according to ASTM C 1353 or ASTM C 241/C 241M and with honed finish.

1. Description: Uniform, fine- to medium-grained white stone with gray veining.
2.5 WATERPROOF AND CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and ANSI A118.12 for standard performance over project substrate and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.


1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. Bonsal American, an Oldcastle company.
   b. Bostik, Inc.
   c. Custom Building Products.
   d. LATICRETE SUPERCAP, LLC.
   e. MAPEI Corporation.

2.6 SETTING MATERIALS

A. Modified Dry-Set Mortar (Thinset): ANSI A118.4.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. Bonsal American, an Oldcastle company.
   b. Bostik, Inc.
   c. Custom Building Products.
   d. LATICRETE SUPERCAP, LLC.
   e. MAPEI Corporation.
   f. TEC / H.B. Fuller Construction Products Inc.

2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.

3. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.

4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

B. Medium-Bed, Modified Dry-Set Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of 5/8 inch (16 mm).

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. Bonsal American, an Oldcastle company.
   b. Bostik, Inc.
   c. Custom Building Products.
   d. LATICRETE SUPERCAP, LLC.
   e. MAPEI Corporation.
   f. TEC / H.B. Fuller Construction Products Inc.
2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.

3. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.

2.7 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.


1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bonsal American, an Oldcastle company.
   b. Bostik, Inc.
   c. Custom Building Products.
   d. LATICRETE SUPERCAP, LLC.
   e. MAPEI Corporation.
   f. TEC / H.B. Fuller Construction Products Inc.

C. High-Performance Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bonsal American, an Oldcastle company.
   b. Bostik, Inc.
   c. Custom Building Products.
   d. LATICRETE SUPERCAP, LLC.
   e. MAPEI Corporation.
   f. TEC / H.B. Fuller Construction Products Inc.

2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

3. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.

D. Water-Cleanable Epoxy Grout: ANSI A118.3[ with a VOC content of 65 g/L or less].

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bonsal American, an Oldcastle company.
   b. Custom Building Products.
   c. LATICRETE SUPERCAP, LLC.
   d. MAPEI Corporation.
   e. TEC / H.B. Fuller Construction Products Inc.
2.8 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Ceramic Tool Company, Inc.
   c. Schluter Systems L.P.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.9 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

   a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
   b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
   a. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.
   b. Tile floors consisting of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
   1. Glazed Wall Tile: 1/16 inch (1.6 mm).
   2. Porcelain Tile: 1/4 inch (6.4 mm).

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
   1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in modified dry-set mortar (thinset).
   2. Do not extend waterproofing or crack isolation membrane under thresholds set in standard dry-set mortar. Fill joints between such thresholds and adjoining tile set on waterproofing or crack isolation membrane with elastomeric sealant.

K. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

3.4 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.5 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

B. Allow crack isolation membrane to cure before installing tile or setting materials over it.
3.6 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer’s written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.7 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:
   1. Ceramic Tile Installation: TCNA F115; thinset mortar; epoxy grout.
      a. Ceramic Tile Type as indicated on finish schedule.
      b. Thinset Mortar: Modified dry-set mortar.
      c. Grout: Water-cleanable epoxy grout.

B. Interior Floor Installations, Wood Subfloor:
   1. Ceramic Tile Installation: modification of TCNA F144; thinset mortar on waterproof membrane over cementitious backer units or fiber-cement backer board.
      a. Ceramic Tile Type as indicated on finish schedule
      b. Thinset Mortar: Modified dry-set or Medium-bed, modified dry-set as recommended by Tile Manufacturer. mortar.
      c. Grout: Water-cleanable epoxy grout.
      d. Waterproofing & Crack Isolation Membrane

C. Interior Wall Installations, Masonry or Concrete:
a. Ceramic Tile Type as indicated on finish schedule

D. Interior Wall Installations, Wood or Metal Studs or Furring:

1. Ceramic Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.

   a. Ceramic Tile Type as indicated on finish schedule
   b. Thinset Mortar: Improved modified dry-set mortar.

E. Bathtub/Shower Wall Installations, Wood or Metal Studs or Furring:

1. Ceramic Tile Installation: TCNA B430; thinset mortar over waterproofing membrane on cementitious backer units or fiber-cement backer board.

   a. Ceramic Tile Type as indicated on finish schedule
   b. Thinset Mortar: Modified dry-set mortar.
   c. Grout: Water-cleanable epoxy grout.
   d. Waterproofing membrane

END OF SECTION 093013
SECTION 09 51 23 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Acoustical tiles for interior ceilings.
2. Fully concealed, direct-hung, suspension systems.
3. Direct attachment of tiles to substrates with adhesive.
4. Direct attachment of tiles to substrates with staples.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Data: For adhesives, indicating VOC content.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Laboratory Test Reports: For ceiling products, indicating compliance with requirements for low-emitting materials.

C. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.

D. Samples for Initial Selection: For components with factory-applied finishes.

E. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Tiles: Set of full-size Samples of each type, color, pattern, and texture.
2. Concealed Suspension-System Members: 6-inch- (150-mm-) long Sample of each type.
3. Exposed Moldings and Trim: Set of 6-inch- (150-mm-) long Samples of each type and color.
F. **Delegated-Design Submittal:** For seismic restraints for ceiling systems.

1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 **INFORMATIONAL SUBMITTALS**

A. **Coordination Drawings:** Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.
   a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical tile.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:
   a. Lighting fixtures.
   b. Diffusers.
   c. Grilles.
   d. Speakers.
   e. Sprinklers.
   f. Access panels.
   g. Perimeter moldings.
7. Show operation of hinged and sliding components adjacent to acoustical tiles.
8. **Minimum Drawing Scale:** 1/8 inch = 1 foot (1:96).

B. **Qualification Data:** For testing agency.

C. **Product Test Reports:** For each acoustical tile ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. **Evaluation Reports:** For each acoustical tile ceiling suspension system and anchor and fastener type, from ICC-ES.

E. **Field quality-control reports.**

1.5 **CLOSEOUT SUBMITTALS**

A. **Maintenance Data:** For finishes to include in maintenance manuals.
1.6 MAINTENANCE MATERIAL SUBMITTALS
A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Acoustical Ceiling Units: Full-size tiles equal to 2 percent of quantity installed.
   2. Suspension-System Components: Quantity of each concealed grid and exposed component equal to 2 percent of quantity installed.

1.7 QUALITY ASSURANCE
A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Build mockup of typical ceiling area as shown on Drawings.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Deliver acoustical tiles, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

1.9 FIELD CONDITIONS
A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
   1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical tile ceiling installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Source Limitations:
   1. Suspended Acoustical Tile Ceilings: Obtain each type of acoustical ceiling tile and its suspension system from single source from single manufacturer.
2. Directly Attached Acoustical Tile Ceilings: Obtain each type of acoustical ceiling tile from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Ceiling products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints for ceiling systems.

C. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

D. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   1. Flame-Spread Index: Class A according to ASTM E 1264.
   2. Smoke-Developed Index: 50 or less.

E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTICAL TILES

A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc; or a comparable product by one of the following:

   1. CertainTeed Corporation.
   2. United States Gypsum Company.

B. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

C. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

D. Tile Design:

   2. "ACT B": Basis of Design: Armstrong “Dune” Tegular Model # 1774, 24" x 24” x 5/8” with 15/16” angled tegular edge with “closed loop recycled content”. Suspension System: 15/16” Prelude. Color: White
4. **“ACT D” Basis of Design:** Armstrong “Cirrus High NRC” Model # 558 24” x 24” x 7/8” beveled tegular lay in tile. Suspension System Suprafine XL 9/16” exposed Tee. Color: White.

5. **“ACP” Direct attached Acoustical Tile:** Basis of Design: Armstrong “Optima CAPZ” Model # 3933WH 48” x 96” x 7/8” reverse tegular. Direct Attach: CAPZ for Optima ARCAPWH. Installed on Prelude XL 15/16” Black Grid. Color: White

E. **Antimicrobial Treatment:** Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

### 2.4 METAL SUSPENSION SYSTEM

A. **Basis-of-Design Product:** Subject to compliance with requirements, provide Armstrong World Industries, Inc; type as indicated above or a comparable product by one of the following:

1. United States Gypsum Company.

B. **Metal Suspension-System Standard:** Provide manufacturer's standard, direct-hung, fully concealed, metal suspension system and accessories of type, structural classification, and finish indicated that complies with applicable requirements in ASTM C 635/C 635M.

1. **High-Humidity Finish:** Where indicated, provide coating tested and classified for "severe environment performance" according to ASTM C 635/C 635M.

C. **Recycled Content:** Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

D. **Direct-Hung, Double-Web Suspension System:** Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation.

1. **Structural Classification:** Heavy-duty system.

2. **Access:** Upward, with initial access openings of size indicated below and located throughout ceiling within each module formed by main and cross runners, with additional access available by progressively removing remaining acoustical tiles.

   a. **Initial Access Opening:** In each module, 24 by 24 inches (610 by 610 mm).

### 2.5 ACCESSORIES

A. **Attachment Devices:** Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, “Direct Hung,” unless otherwise indicated. Comply with seismic design requirements.

1. **Anchors in Concrete:** Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to
ASTM E 488/E 488M or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

a. Type: Cast-in-place anchors.
b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B 633, Class SC 1 (mild) service condition.
c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
3. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- (2.69-mm-) diameter wire.

C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.

F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate lateral forces.

H. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical tiles in-place during a seismic event.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Basis-of-Design: Subject to compliance with requirements, provide Armstrong World Industries, Inc; products or comparable products by one of the following:

1. CertainTeed Corporation.
2. Chicago Metallic Corporation.
3. Fry Reglet Corporation.
B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for of suspension-system runners.
   1. Basis of design - Armstrong Channel Molding #7830
   2. Finish: Painted in color as selected from manufacturer's full range.
   3. Install at clouds, typical throughout.
   4. Height - 2"

C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.
   1. Basis of design - Armstrong Axiom
   2. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
   3. Install at clouds at Lecture Hall B13
   4. Height - 4"

2.7 ACOUSTICAL SEALANT
A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

2.8 MISCELLANEOUS MATERIALS
A. Acoustical Tile Adhesive: Type recommended in writing by acoustical tile manufacturer, bearing UL label for Class 0-25 flame spread.
   1. Adhesives shall have a VOC content of 50 g/L or less.
   2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
B. Staples: 5/16-inch- (8-mm-) long, divergent-point staples.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine acoustical tiles before installation. Reject acoustical tiles that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Testing Substrates: Before adhesively bonding tiles to wet-placed substrates such as cast-in-place concrete or plaster, test and verify that moisture level is below tile manufacturer’s recommended limits.

B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

C. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

A. Install suspended acoustical tile ceilings according to ASTM C 636/C 636M, seismic design requirements, and manufacturer’s written instructions.

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

B. Suspend ceiling hangers from building’s structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.
   1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
   2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends. Miter corners accurately and connect securely.
   3. Use of exposed fasteners, including pop rivets, is limited to perimeter trim at ACT clouds.
   4. Install wall attachment with no exposed fasteners at perimeter wall angle.
      a. Basis of design: Grip Clip Wall Attachment (#GCWA) by Armstrong Industries

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Arrange directionally patterned acoustical tiles as follows:
   1. As indicated on reflected ceiling plans.
   2. Install tiles with pattern running in one direction parallel to long axis of space, if not indicated on drawings.

G. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges of tiles so tile-to-tile joints are interlocked.
   1. Fit adjoining tiles to form flush, tight joints. Scribe and cut tiles for accurate fit at borders and around penetrations through ceiling.
   2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tiles and moldings, spaced 12 inches (305 mm) o.c.
   3. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 INSTALLATION OF DIRECTLY ATTACHED ACOUSTICAL TILE CEILINGS

A. Adhesive Installation: Install acoustical tile by bonding to substrate, using acoustical tile adhesive and procedure recommended in writing by tile manufacturer and as follows:
   1. Wipe and prime ceiling.
   2. Remove loose dust from backs of tiles by brushing.
   3. Install splines in joints between tiles and maintain bottom surface to a uniform level. Shim tile or correct substrate as required to maintain levelness.
   4. Maintain tight butt joints, aligned in both directions and coordinated with ceiling fixtures.

B. Stapled Installation: Fasten acoustical tile to substrate using a minimum of two staples per tile that are installed in flanges of tile and as follows:
1. Form double-lapped joint between tiles by securely pressing tile tongues into corresponding tile grooves.
2. Maintain bottom surface of tiles to a uniform level. Shim tile or correct substrate as required to maintain levelness.
3. Maintain tight butt joints, aligned in both directions and coordinated with ceiling fixtures.

C. Install edge moldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical units.

D. Arrange directionally patterned acoustical tiles as indicated on Drawings.

3.5 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

B. Directly Attached Ceilings: Install bottom surface of tiles to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m) and not exceeding 1/4 inch (6 mm) cumulatively.

C. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections of completed installations of acoustical tile ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no tiles have been installed. Do not proceed with installations of acoustical tile ceiling hangers for the next area until test results for previously completed installations of acoustical tile ceiling hangers show compliance with requirements.

1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.

2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

C. Acoustical tile ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.7 ADJUSTING

A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer’s written instructions for cleaning and touchup of minor finish damage.
B. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 23
SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient molding accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. **Product Data**: For adhesives, indicating VOC content.
2. **Laboratory Test Reports**: For adhesives, indicating compliance with requirements for low-emitting materials.
3. **Laboratory Test Reports**: For resilient base, indicating compliance with requirements for low-emitting materials.

C. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.

D. Samples for Initial Selection: For each type of product indicated.

E. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.

F. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.
1.5 QUALITY ASSURANCE
   A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic
effects and set quality standards for materials and execution.
      1. Coordinate mockups in this Section with mockups specified in other Sections.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient
temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10
deg C) or more than 90 deg F (32 deg C).

1.7 FIELD CONDITIONS
   A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F
(21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following
time periods:
      1. 48 hours before installation.
      2. During installation.
      3. 48 hours after installation.
   B. After installation and until Substantial Completion, maintain ambient temperatures within range
recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
   C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. Resilient base shall comply with the requirements of the California Department of Public Health's
"Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor
Sources Using Environmental Chambers."

2.2 THERMOSET-RUBBER BASE
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. Burke Mercer Flooring Products; a division of Burke Industries Inc.
      2. Flexco.
      3. Johnsonite; a Tarkett company.
      4. Roppe Corporation, USA.
   B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
1. Style and Location:
   a. As indicated on finish schedule

C. Thickness: 0.125 inch (3.2 mm).

D. Height: As indicated on Drawings.

E. Lengths: Coils in manufacturer’s standard length.

F. Outside Corners: Job formed or preformed.

G. Inside Corners: Job formed.

H. Colors: as indicated on finish schedule.

2.3 RUBBER MOLDING ACCESSORY</Insert drawing designation>

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Johnsonite.
   2. Roppe Corporation, USA.
   3. VPI Corporation.

B. Description: Rubber tile and carpet transition strips.

C. Profile and Dimensions: as required for minimal exposure meeting ADA requirements.

D. Locations: At all locations where flooring material changes and where flooring material thickness changes, except for metal transition strips used at transitions to porcelain tile (as specified in Division 09 Tile section).

E. Colors and Patterns: Match floor color.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
   1. Adhesives shall have a VOC content of 50 g/L or less.

C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.

D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.
E. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer’s written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to manufacturer’s written recommendations, but not less stringent than the following:
   a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
   b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are the same temperature as the space where they are to be installed.
1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:
   1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
      a. Form without producing discoloration (whitening) at bends.
   2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
      a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:
   1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
   2. Tightly adhere to substrates throughout length of each piece.
   3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.
3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum horizontal surfaces thoroughly.
   3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 65 13
SECTION 09 65 16 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes vinyl sheet flooring.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Product Data: For chemical-bonding compounds, indicating VOC content.
4. Laboratory Test Reports: For chemical-bonding compounds, indicating compliance with requirements for low-emitting materials.
5. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For each type of flooring. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

D. Samples for Verification: In manufacturer's standard size, but not less than 6-by-9-inch (150-by-230-mm) sections of each different color and pattern of resilient sheet flooring required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches (230 mm) long, of each color required.

E. Welded-Seam Samples: For seamless-installation technique indicated and for each resilient sheet flooring product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch (150-by-230-mm) Sample applied to a rigid backing and prepared by Installer for this Project.

F. Product Schedule: For resilient sheet flooring. Use same designations indicated on Drawings.
1.4  INFORMATIONAL SUBMITTALS
   A.  Qualification Data: For Installer.

1.5  CLOSEOUT SUBMITTALS
   A.  Maintenance Data: For each type of resilient sheet flooring to include in maintenance manuals.

1.6  MAINTENANCE MATERIAL SUBMITTALS
   A.  Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1.  Resilient Sheet Flooring: Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, in roll form and in full roll width for each type, color, and pattern of flooring installed.

1.7  QUALITY ASSURANCE
   A.  Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for resilient sheet flooring installation and seaming method indicated.

   1.  Engage an installer who employs workers for this Project who are trained or certified by resilient sheet flooring manufacturer for installation techniques required.

1.8  DELIVERY, STORAGE, AND HANDLING
   A.  Store resilient sheet flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store rolls upright.

1.9  FIELD CONDITIONS
   A.  Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 85 deg F (29 deg C), in spaces to receive resilient sheet flooring during the following time periods:

   1.  48 hours before installation.
   2.  During installation.
   3.  48 hours after installation.

   B.  After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

   C.  Close spaces to traffic during resilient sheet flooring installation.

   D.  Close spaces to traffic for 48 hours after resilient sheet flooring installation.

RESILENT SHEET FLOORING  09 65 16 - 2
E. Install resilient sheet flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Flooring products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 UNBACKED VINYL SHEET FLOORING

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Armstrong World Industries, Inc. (Basis of Design)
2. Other manufacturers, subject to matching product approved by architect:
3. Johnsonite; a Tarkett company.
4. Mannington Mills, Inc.
5. Shaw Contract Group; a Berkshire Hathaway company.


C. Thickness: 0.080 inch (2.0 mm).

D. Wearing Surface: Smooth.

E. Sheet Width: As standard with manufacturer] 6 feet (1.8 m).


G. Colors and Patterns: Match Architect's sample as indicated on finish drawings.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient sheet flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.
1. **Adhesives shall have a VOC content of 50 g/L or less.**

C. Seamless-Installation Accessories:


D. Integral-Flash-Cove-Base Accessories:

1. Cove Strip: Smallest radius provided or approved by resilient sheet flooring manufacturer.
2. Cap Strip: Square metal, vinyl, or rubber cap provided or approved by resilient sheet flooring manufacturer.
3. Corners: Metal inside and outside corners and end stops provided or approved by resilient sheet flooring manufacturer.

E. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient sheet flooring manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

   1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient sheet flooring.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.

B. Concrete Substrates: Prepare according to ASTM F 710.

   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
   4. Moisture Testing: Proceed with installation only after substrates pass testing according to resilient sheet flooring manufacturer's written recommendations, but not less stringent than the following:
a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.

b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient sheet flooring until it is the same temperature as the space where it is to be installed.

1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

3.3 RESILIENT SHEET FLOORING INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient sheet flooring.

B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.

C. Lay out resilient sheet flooring as follows:

1. Maintain uniformity of flooring direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (152 mm) away from parallel joints in flooring substrates.
3. Match edges of flooring for color shading at seams.
4. Avoid cross seams.

D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and door frames.

E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install resilient sheet flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.

H. Adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Seamless Installation:
1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to permanently fuse sections into a seamless flooring. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

2. Chemically Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless flooring. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on flooring surfaces.

J. Integral-Flash-Cove Base: Cove resilient sheet flooring 6 inches (152 mm) up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.

1. Install metal corners at inside and outside corners.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient sheet flooring.

B. Perform the following operations immediately after completing resilient sheet flooring installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient sheet flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from flooring surfaces before applying liquid floor polish.

1. Apply three coat(s).

E. Cover resilient sheet flooring until Substantial Completion.

END OF SECTION 09 65 16
SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Luxury vinyl floor tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.

2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

3. Laboratory Test Reports: For flooring products, indicating performance of low-emitting materials.

C. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

D. Samples for Verification: Full-size units of each color and pattern of floor tile required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches (230 mm) long, of each color required.

E. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.
1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.9 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

1.10 WARRANTY

A. Luxury Vinyl Tile: 10 year commercial wear warranty and 10 year under bed warranty

B. Static Dissipative Tile: Five year warranty on manufacturing defects and installation integrity
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 LUXURY VINYL FLOOR TILE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Shaw Contract Group, a Berkshire Hathaway company. (Basis of Design)

2. Other manufacturer's subject to match of selected product as determined by architect:

3. Armstrong World Industries, Inc.
4. TOLI International.

B. Tile Standard: ASTM F 1700.

2. Type: B, embossed surface.

C. Thickness: 0.098 inch.

D. Size: 7" wide x 48" long

E. Colors and Patterns: Match Architect's sample as designated on finish schedule.

2.3 STATIC DISSIPATIVE VINYL COMPOSITION FLOOR TILE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc. (Basis of Design)
2. Congoleum Corporation.
3. Mannington Mills, Inc.

B. Tile Standard: ASTM F 1066, Class 2, through-pattern tile.

C. Resistance: ESD-S7.1 and ASTM F-150 Point to point and point to ground: $10^6$ to $10^9$ ohms

D. Static Generation: ESD STM 97.2 (flooring in combination with footwear and person), at 40% RH with ESD shoes: <10 volts. At 12% RH with ESD shoes: <100 volts

E. Static Decay: Flooring in combination with footwear (ESD shoes) and a person (5000 volts to zero): 0.5 seconds avg. Fed. Test 10C, method 4046 (5000 volts to zero): <0.5 seconds

F. Wearing Surface: Smooth.
G. Thickness: 0.125 inch (3.2 mm).

H. Size: 12 by 12 inches (305 by 305 mm).

I. Colors and Patterns: As indicated on finish schedule.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

1. Adhesives shall have a VOC content of 60 g/L or less.

C. Static Dissipative Floor Tile Areas:

1. Static dissipative adhesive per adhesive requirements above and as recommended by manufacturer for use in static dissipative floor system, (equal to Armstrong S-202)
2. Copper Grounding Strips
3. Static dissipative polish as recommended by flooring manufacturer (equal to Armstrong S-392)

D. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

E. Acoustic Underlayment:

1. Acoustic underlayment mat as recommended by flooring manufacturer for system compatibility. Blend of cork and recycled EVA foam granules. Basis of Design product: Shaw Hush II (Style 071VS) 2.5mm thick mat, IIC rating (ASTM E492/E989) with dry back LVT over 8” concrete: 55.
2. Use at locations indicated on finish plans.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer’s written instructions to ensure adhesion of resilient products.
B. Concrete Substrates: Prepare according to ASTM F 710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
   4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
      a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
      b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

C. Refer to Manufacturer's instructions for preparation of wood substrates.

D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

E. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
   1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

G. At static dissipative tile areas, tile must be installed as a system using SDT Tile, SDT adhesive, copper grounding strips packaged with the adhesive, and SDT polish. Coordinate with electrician to connect copper strip system to grounding bus.

H. Install underlayment for moisture or acoustics at locations indicated on floor plans in accordance with manufacturer’s written instructions.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
   1. Lay tiles in pattern indicated.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern).

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
   1. Apply three coat(s).

E. Cover floor tile until Substantial Completion.

END OF SECTION 09 65 19
SECTION 09 68 13 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes modular carpet tile.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
      a. Review delivery, storage, and handling procedures.
      b. Review ambient conditions and ventilation procedures.
      c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include manufacturer’s written data on physical characteristics, durability, and fade resistance.
   2. Include manufacturer’s written installation recommendations for each type of substrate.

B. Sustainable Design Submittals:
   1. **Product Data**: For adhesives, indicating VOC content.
   2. **Laboratory Test Reports**: For adhesives, indicating compliance with requirements for low-emitting materials.
   3. **Laboratory Test Reports**: For flooring products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For carpet tile installation, plans showing the following:
   1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
   2. Carpet tile type, color, and dye lot.
   3. Type of subfloor.
   4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

D. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer’s name, material description, color, pattern, and designation indicated on Drawings and in schedules.

2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

E. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer’s name, material description, color, pattern, and designation indicated on Drawings and in schedules.

2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

F. Product Schedule: For carpet tile. Use same designations indicated on Drawings.


1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer’s recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).
1.8 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II or Master II certification level.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI's "CRI Carpet Installation Standard."

1.10 FIELD CONDITIONS

A. Comply with CRI’s "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.

2. Failures include, but are not limited to, the following:

   a. More than 10 percent edge raveling, snags, and runs.
   b. Dimensional instability.
   c. Excess static discharge.
   d. Loss of tuft-bind strength.
   e. Loss of face fiber.
   f. Delamination.

3. Warranty Period: Lifetime commercial limited warranty.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Shaw Contract Group; a Berkshire Hathaway company. (Basis of Design Product)

2. Interface, LLC.

3. Patcraft; a division of Shaw Industries, Inc.

B. Color: Match Architect's samples as indicated on finish schedule

C. Pattern: Match Architect's samples.

D. Fiber Content: 100 percent nylon 6.

E. Pile Characteristic: multi level pattern loop.

F. Density: <Insert oz./cu. yd. (g/cu. cm)>.

G. Stitches: 9 stitches per inch (mm).

H. Gage: 1/12

I. Primary Backing/Backcoating: Manufacturer's standard composite materials.


L. Size: 24 by 24 inches (610 by 610 mm).

M. Applied Treatments:


N. Sustainable Design Requirements:

1. Sustainable Product Certification: Gold level certification according to ANSI/NSF 140.

2. Carpet and cushion shall comply with testing and product requirements of CRI's "Green Label Plus" testing program.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

1. Adhesives shall have a VOC content of 50 g/L or less.
2. **Adhesive shall comply with the** testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

**PART 3 - EXECUTION**

### 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
   
   a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
   
   b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
   
   c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

D. Wood Subfloors: Verify the following:

1. Underlayment over subfloor complies with requirements specified in Section 061600 "Sheathing."
2. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

E. Metal Subfloors: Verify the following:

1. Underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

F. Painted Subfloors: Perform bond test recommended in writing by adhesive manufacturer.

1. Access Flooring Systems: Verify the following:
   
   2. Access floor substrate is compatible with carpet tile and adhesive if any.
3. Underlayment surface is flat, smooth, evenly planed, tightly jointed, and free of irregularities, gaps greater than 1/8 inch (3 mm), protrusions more than 1/32 inch (0.8 mm), and substances that may interfere with adhesive bond or show through surface.

G. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns indicated on Drawings.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:
1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.

B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 68 13
SECTION 09 72 00 –WALL COVERINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Dry-Erase Projection Surface Wall Covering.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.

2. Manufacturer's written installation instructions.

3. Manufacturer's written instructions for recommended maintenance of each type of dry erase wall covering required.

B. Sustainable Design Submittals:

1. **Product Data**: For adhesives, indicating VOC content.

2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

3. **Laboratory Test Reports**: For wall materials, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement, seams and termination points.

D. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by size indicated on drawings.

1. Wall-Covering Sample: From same production run to be used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of fabric.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.
B. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wall-Covering Materials: For each type, color, texture, and finish, full width by 60 inch length.

1.7 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for installation.

1. Build mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F 1141 for appearance shading characteristics.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

B. Installer: Installation by skilled commercial wallcovering contractor with no less than three years of documented experience installing dry erase wallcovering of the types and extent required

1.8 WARRANTY

A. Submit manufacturer's limited five-year written warranty against manufacturing defects

1.9 MAINTENANCE

A. Maintenance instructions: Include precautions against cleaning materials and methods that may be detrimental to finishes and performance.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.

B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.
C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   a. Flame-Spread Index: 25 or less (Class A)
   b. Smoke-Developed Index: 450 or less.

2.2 DRY ERASE PROJECTION WALL COVERING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. 3M.
   2. Da-Lite.
   3. Koroseal Interior Products (Basis of Design)

B. Product: Smooth low gloss vinyl surface for projection and dry erase markers


   2. Subject to owner and architect approval of 60” x 60” test sample.

2.3 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining, adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.

B. Primer/Sealer: Mildew resistant, complying with requirements and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.

C. Seam Tape: As recommended in writing by wall-covering manufacturer.

D. Aluminum Tray with end caps – full length of installation, clear satin anodized aluminum for markers and erasers.

E. Wood trim as indicated on drawings. Coordinate scoping and installation with general contractor regarding finished carpentry and trim around presentation area.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work. Substrate shall meet requirements of Level 5 gypsum board finish.

B. Proceed with installation only after unsatisfactory conditions have been corrected. Beginning of installation means acceptance of surface conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Moisture Content: Maximum of 4 percent when tested with an electronic moisture meter.
2. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
3. Painted Surfaces: Treat areas susceptible to pigment bleeding.

D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.

E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 WALL-COVERING INSTALLATION

A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.

B. Cut wall-covering strips in roll number sequence.

C. Install strips horizontally using a level line in same order as cut from roll.
   1. Reverse hang alternate strips (except lined products). Do not crease or bend the wallcovering when handling.

D. Install wall covering without lifted or curling edges and without visible shrinkage.
E. Obtain architect’s approval prior to installation regarding number and location of vertical seams (minimize). Horizontal seams are not permitted.

F. Using a level or straight edge, double cut the seam with a seam-cutting tool (Ex: Double Seam-Cutter or Swedish Knife). Do not score drywall or plasterboard when cutting material. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.

G. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

H. Apply wallcovering to the substrate using a wallcovering smoother, wrapped with a soft cloth, to remove air bubbles. Do not use sharp edged smoothing tools. Smooth material on the wall from the middle to the outside edge.

I. Remove excess adhesive immediately after the wallcovering is applied. Clean entire surface with a warm mild soap solution, and clean soft cloths. Rinse thoroughly with water and let dry before using. Change water often to maintain water clarity.

J. Stop installation of material that is questionable in appearance and notify the manufacturer's representative for an inspection.

3.4 CLEANING

A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.

B. Use cleaning methods recommended in writing by wall-covering manufacturer.

C. Replace strips that cannot be cleaned.

D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

E. Upon completion of the work, remove surplus materials, rubbish, and debris resulting from the wallcovering installation. Leave areas in neat, clean, and orderly condition.
SECTION 09 90 00 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section includes surface preparation and the application of paint systems on interior and exterior surfaces, including high performance coatings.

B. Related Requirements:
   1. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.
   2. Section 02 82 33 Removal and Disposal of Asbestos Containing Materials related to substrates containing ACM
   3. Section 02 83 19.13 Lead Based Paint Removal and Disposal
   4. Section 02 86 00 Other Hazardous Materials Abatement
   5. Section 09 03 91 Historic Treatment of Plain Painting

1.3 REFERENCES
B. Steel Structures Painting Council (SSPC) SP6 - Commercial Blast Cleaning Procedures.
C. Steel Structures Painting Council (SSPC) SP10 - Near White Blast Cleaning Procedure.

1.4 DEFINITIONS
A. “Extra-Flat” MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
B. “Flat” - MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
C. “Eggshell” - MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
D. “Satin” - MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
E. "Semi-Gloss" - MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. "Gloss" - MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. "High Gloss" - MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

2. Indicate VOC content.

B. Sustainable Design Submittals:

1. Product Data: For paints and coatings, indicating VOC content.

2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.

2. Apply coats on Samples in steps to show each coat required for system.

3. Label each coat of each Sample.

4. Label each Sample for location and application area.

D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Qualified individuals within a firm with expertise in matching and touching up existing painting. Experience only in new painting work is insufficient experience for historic treatment work. Installer shall have experience in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
   a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
   b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.
   a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label:

B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.9 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 90 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
   1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within limits specified during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Benjamin Moore & Co.
2. Dulux (formerly ICI Paints); a brand of AkzoNobel.
3. PPG Architectural Coatings.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Interior Painting Schedule for the paint category indicated.

C. Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:
   1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
   1. Flat Paints and Coatings: 50 g/L.
   2. Nonflat Paints and Coatings: 150 g/L.
   3. Dry-Fog Coatings: 400 g/L.
   4. Primers, Sealers, and Undercoaters: 200 g/L.
   5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
   7. Pretreatment Wash Primers: 420 g/L.
   8. Shellacs, Clear: 730 g/L.
   9. Shellacs, Pigmented: 550 g/L.

D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Colors: As indicated in the drawings and finish schedule.
   1. Paint exposed surfaces. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.

2. Testing agency will perform tests for compliance with product requirements.

3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

   1. Concrete: 12 percent.
   2. Fiber-Cement Board: 12 percent.
   3. Masonry (Clay and CMUs): 12 percent.
   5. Gypsum Board: 12 percent.
   6. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured.

E. Textured Ceiling Substrates: Verify that surfaces are dry.

F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

G. Proceed with coating application only after unsatisfactory conditions have been corrected.

   1. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

   2. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Refer to Section 09 03 91 Historic Treatment of Plain Painting for preparation of existing and/or historic surfaces.
B. Comply with manufacturer’s written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

C. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

D. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

2. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

E. Concrete Substrates: Remove release agents, curing compounds, efflorescence, dust, dirt, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer’s written instructions.

F. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer’s written instructions.

G. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 3 (preparation in field)

2. SSPC-SP 7/NACE No. 4 (preparation off-site only)

H. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

I. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

J. Aluminum Substrates: Remove loose surface oxidation.

K. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.

2. Sand surfaces that will be exposed to view, and dust off.

3. Prime edges, ends, faces, undersides, and backsides of wood.

4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

L. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.
M. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
6. Do not paint prefinished items unless specifically noted otherwise.
7. Paint both sides and edges of field-painted doors and entire exposed surface of exterior door frames.
8. Paint entire exposed surface of window frames and sashes.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:
   a. Equipment, including panelboards and switch gear.
   b. Uninsulated and Insulated metal piping.
   c. Uninsulated and Insulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.
   g. Tanks that do not have factory-applied final finishes.
   h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   i. All other items for which painting is not prohibited by code or product manufacturer

2. Paint the following work where exposed in occupied spaces:
a. Equipment, including panelboards.
b. Uninsulated and Insulated metal piping.
c. Uninsulated and Insulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
h. Other items as directed by Architect.
i. All other items for which painting is not prohibited by code or product manufacturer

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

4. All exterior metal piping, conduits and ferrous metal substrates shall be painted.

3.4 FIELD QUALITY CONTROL
A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
   1. Contractor shall touch up and restore painted surfaces damaged by testing.
   2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION
A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINT SYSTEMS
Note: This is a basis of design schedule. Equal products by manufacturers listed in Section 2 may be used.
A. Wood Trim, Brackets and Soffits: Provide the following finish systems over exterior wood: Acrylic-Enamel Finish: Two finish coats over a primer.
   1. Primer: PPG Paints; 17-921 Seal Grip 100 Percent Acrylic Universal Primer: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).
   2. Exterior semigloss acrylic enamel finish: PPG Paints; 6-900XI Series SpeedHide Exterior House and Trim Semi-Gloss Acrylic Latex Paint: Applied at a dry film thickness of not less than 1.5 mils (0.038 mm).

B. Dormers: Provide the following finish systems over exterior dormers: Acrylic-Enamel Finish: Two finish coats over a primer.
   1. Primer: PPG Paints; 17-921 Seal Grip 100 Percent Acrylic Universal Primer: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).
   2. Exterior semigloss acrylic enamel finish: PPG Paints; 6-900XI Series SpeedHide Exterior House and Trim Semi-Gloss Acrylic Latex Paint: Applied at a dry film thickness of not less than 1.5 mils (0.038 mm).

C. Galvanized Metal: Provide the following finish systems over exterior galvanized metal surfaces: Gloss Finish: One finish coat over an intermediate coat and a primer.
   1. Primer: Epoxy primer.
   2. PPG; Amerlock One- One Pack Epoxy Coating applied at a spread rate of 4.0 to 6.0 mils DFT.
   3. Intermediate Coat: Polysiloxane enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 3.0 mils
      4. PPG; PSX One- One Pack Polysiloxane Coating.
   5. Topcoat: Polysiloxane enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 3.0 mils
      6. PPG; PSX One- One Pack Polysiloxane Coating.

D. Metal Railing: Provide the following finish systems over exterior metal railings: Gloss Finish: One finish coat over an intermediate coat and a primer.
   1. Primer: Epoxy primer.
   2. PPG; Amerlock One- One Pack Epoxy Coating applied at a spread rate of 4.0 to 6.0 mils DFT.
   3. Intermediate Coat: Polysiloxane enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 3.0 mils
      4. PPG; PSX One- One Pack Polysiloxane Coating.
   5. Topcoat: Polysiloxane enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 3.0 mils
      6. PPG; PSX One- One Pack Polysiloxane Coating.

E. Metal Deck plate edges: Provide the following finish systems over exterior metal deck plate/angle edge surfaces: Gloss Finish: One finish coat over an intermediate coat and a primer.
   1. Primer: Epoxy primer.
   2. PPG; Amerlock One- One Pack Epoxy Coating applied at a spread rate of 4.0 to 6.0 mils DFT.
   3. Intermediate Coat: Polysiloxane enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 3.0 mils
      4. PPG; PSX One- One Pack Polysiloxane Coating.
   5. Topcoat: Polysiloxane enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 3.0 mils
      6. PPG; PSX One- One Pack Polysiloxane Coating.
3.7 INTERIOR PAINT SYSTEMS

Note: This is a basis of design schedule. Equal products by manufacturers listed in Section 2 may be used.

A. Concrete and Masonry (Other Than Concrete Unit Masonry): Provide the following paint systems over interior concrete masonry substrates: Acrylic Finish: Two finish coats over a primer.
   1. Primer: PPG Paints; 4-603 Perma-Crete Interior/Exterior Alkali Resistant Primer. Applied at a dry film thickness of not less than 1.2 mils (0.030 mm).
   2. Interior low-luster acrylic enamel finish: PPG Paints; 6-411 Series SpeedHide Eggshell Acrylic Latex Enamel: Applied at a dry film thickness of not less than 1.25 mils (0.032 mm).

B. Brick: Provide the following paint systems over interior brick masonry substrates: Acrylic Finish: Two finish coats over a primer.
   1. Primer: PPG Paints; 4-603 Perma-Crete Interior/Exterior Alkali Resistant Primer. Applied at a dry film thickness of not less than 1.2 mils (0.030 mm).
   2. Interior low-luster acrylic enamel finish: PPG Paints; 6-411 Series SpeedHide Eggshell Acrylic Latex Enamel: Applied at a dry film thickness of not less than 1.25 mils (0.032 mm).

C. Concrete Unit Masonry: Provide the following finish systems over interior concrete masonry: Acrylic Finish: Two finish coats over a block filler.
   1. Block Filler: Block Filler: PPG Paints; 6-7 SpeedHide Interior/Exterior Masonry Latex Block Filler: Applied at a dry film thickness of not less than 6.0 to 12.5 mils (0.152 to 0.318 mm).
   2. Interior low-luster acrylic enamel finish: PPG Paints; 6-411 Series SpeedHide Eggshell Acrylic Latex Enamel: Applied at a dry film thickness of not less than 1.25 mils (0.032 mm).

D. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces: Acrylic Finish: Two finish coats over a primer.
   1. Primer: PPG Paints; 6-2 SpeedHide Interior Quick-Drying Latex Sealer: Applied at a dry film thickness of not less than 1.0 mil (0.025 mm).
   2. Interior low-luster acrylic enamel finish: PPG Paints; 6-411 Series SpeedHide Eggshell Acrylic Latex Enamel: Applied at a dry film thickness of not less than 1.25 mils (0.032 mm).
   3. Flat Finish (ceilings only):

E. Gypsum Board - Epoxy Provide the following finish systems over interior gypsum board surfaces where epoxy finish is indicated on finish schedule: Two finish coats over a primer.
   1. Primer: PPG Paints; 17-921 Seal Grip 100 Percent Acrylic Universal Primer: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).
   2. Interior low-luster Pre-Catalyzed Water-Borne Acrylic Epoxy finish: PPG Paints; 16-310 Series Pitt-Glaze WB1 Interior Eggshell Pre-Catalyzed Water-Borne Acrylic Epoxy: Applied at a dry film thickness of not less than 2.5 mils.

F. Plaster: Provide the following finish systems over interior plaster surfaces: Acrylic Finish: Two finish coats over a primer.
   1. Primer: PPG Paints; 17-921 Seal Grip 100 Percent Acrylic Universal Primer: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).
   2. Interior low-luster acrylic enamel finish: PPG Paints; 6-411 Series SpeedHide Eggshell Acrylic Latex Enamel: Applied at a dry film thickness of not less than 1.25 mils (0.032 mm).

G. Wood Trim, Deck and Columns: Provide the following paint finish systems over interior wood surfaces: Acrylic-Enamel Finish: Two finish coats over a primer.
1. Primer for Acrylic-Enamel Finishes: PPG Paints; 17-921 Seal Grip 100 Percent Acrylic Universal Primer. Applied at a dry film thickness of not less than 1.6 mils (0.040 mm).
2. Interior semigloss acrylic enamel: PPG Paints; 6-500 Series SpeedHide Interior Semi-Gloss Latex: Applied at a dry film thickness of not less than 1.0 mil (0.025 mm).

H. Hollow Metal Door Frames: Provide the following finish systems over hollow metal door frames: Acrylic Finish: Two finish coats over a primer.
   1. Primer: PPG; 90-712 Pitt-Tech Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
   2. Acrylic Enamel Finish: Two finish coats over a primer.
      Interior Semi-gloss acrylic enamel finish: PPG; 90-1210 Series Pitt-Tech Plus Interior/Exterior Semi-gloss DTM Industrial Enamel: Applied at a dry film thickness of not less than 2.0 mils (0.050 mm).

I. Exposed Steel Decking/Steel Pan Stair-Dry Fall Finish: Two finish coats over a primer.
   1. Primer: PPG; 90-712 Pitt-Tech Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
   2. Interior semigloss alkyd enamel finish: PPG Paints; 6-725XI Speedhide Super Tech WB Interior Dry-Fog Flat Latex: Applied at a dry film thickness of not less than 2.2 mils (0.056 mm).

J. Insulated Piping (elastomeric foam type)
   1. 1st Coat: PPG Paints 17-921 Seal Grip Int/Ext 100% Acrylic Universal Primer
   2. 2nd Coat: 90-474 Series (Satin) Series Pitt Tech Int/Ext 100% Acrylic DTM Industrial Enamel
   3. 3rd Coat: 90-474 Series (Satin) Series Pitt Tech Int/Ext 100% Acrylic DTM Industrial Enamel

END OF SECTION 09 90 00
SECTION 09 93 00 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and application of wood stains and transparent finishes.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

D. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

E. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
2. Indicate VOC content.

B. Sustainable Design Submittals:

1. Product Data: For paints and coatings, indicating VOC content.
2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.

C. Samples for Initial Selection: For each type of product.

D. Samples for Verification: For each type of finish system and in each color and gloss of finish required.

1. Submit Samples on representative samples of actual wood substrates, 8 inches (200 mm) square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

E. Product List: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Stains and Transparent Finishes: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
   a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
   b. Other Items: Architect will designate items or areas required.

2. Final approval of stain color selections will be based on mockups.
   a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply finishes when relative humidity exceeds 85 percent, at temperatures less than 5 deg F (3 deg C) above the dew point, or to damp or wet surfaces.
C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. Dulux (formerly ICI Paints); a brand of AkzoNobel.
3. PPG Architectural Coatings.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in wood finish systems schedules for the product category indicated.

2.2 MATERIALS, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Clear Wood Finishes, Varnishes: 350 g/L.
2. Clear Wood Finishes, Lacquers: 550 g/L.
3. Shellacs, Clear: 730 g/L.
4. Stains: 250 g/L.

D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

E. Stain Colors: Match Architect's sample as indicated on finish schedule.

2.3 SOURCE QUALITY CONTROL

A. Testing of Materials: Owner reserves the right to invoke the following procedure:
1. Owner will engage the services of a qualified testing agency to sample wood finishing materials. Contractor will be notified in advance and may be present when samples are taken. If materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying wood finishes if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying materials from Project site, pay for testing, and refinish surfaces finished with rejected materials. Contractor will be required to remove rejected materials from previously finished surfaces before refinishing with complying materials if the two finishes are incompatible or produce results that, in the opinion of the Architect, are aesthetically unacceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

C. Maximum Moisture Content of Interior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with finish application only after unsatisfactory conditions have been corrected.

1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.

2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

3. Countersink steel nails, if used, and fill with putty or plastic wood filler tinted to final color. Sand smooth when dried.

D. Interior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.

2. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.

3. Sand surfaces exposed to view and dust off.

4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for finish and substrate indicated.

2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.

3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

1. Polyurethane Varnish over Stain System MPI INT 6.1J:
a. Stain Coat: Stain, semitransparent, for interior wood, MPI 90, MPI VOC range E3.


d. Topcoat: Varnish, interior, polyurethane, oil modified, satin (MPI Gloss Level 4), MPI 57, MPI VOC Range E3.

2. Polyurethane Varnish System MPI INT 6.1D:

   c. Topcoat: Varnish, interior, polyurethane, oil modified, satin (MPI Gloss Level 4), MPI 57, MPI VOC Range E3.
SECTION 10 14 00 - EXTERIOR ACCESSIBLE DIRECTIONAL SIGNAGE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Exterior Signage Systems:
   1. Accessible directional signage.

1.2 RELATED SECTIONS

A. Division 01 Specifications.

1.3 REFERENCES

A. Americans with Disabilities Act (ADA).

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00 - Submittal Procedures.
B. Product Data: Manufacturer’s data sheets on each product to be installed.
C. Shop Drawings: Shop drawings with letter style, general layout and arrow directions for each sign type, with sizes, edge and corner treatment, and mounting methods shown.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall have five years experience manufacturing and fabricating products of similar type and scope as those specified in this section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's recommendations for delivery, storage and handling.
B. Materials shall be delivered to the location in unopened, labeled factory containers. Upon delivery, materials shall be inspected for damage. Deficient materials shall not be used.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

B. CCSW, which is located at: P. O. Box 2189 502 S. Staples (78401); Corpus Christi, TX 78403; Toll Free Tel: 800-322-4515; Tel: 361-884-4801; Fax: 800-354-6416; Email: request; Web:www.ccswsignsystems.com

C. Seton Identification Products, 20 Thompson Rd.; Branford, CT 06405-2842; ASD. Toll Free Tel: 800-243-6624; Tel: 203-488-8059; Fax: 800-345-7819; Email:aecinfo@seton.com; Web:www.seton.com/aec.

D. Requests for substitutions will be considered in accordance with provisions of Section 01 25 13 - Product Substitution Procedures.

2.2 EXTERIOR ACCESSIBLE DIRECTIONAL SIGNAGE:

A. Material: .080 inch (2 mm) Aluminum.

B. Graphics: 'Accessible Entrance' with International Symbol of Access (ISA) and directional arrow. Indicate arrows on shop drawings before installation.

C. Post: 2” Galvanized square

D. Post finish: Powder coated black

E. Post height: Verify with Architect in field

F. Provide all hardware for a complete installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Installer shall examine signs for defects, damage, and compliance with specifications. Installation shall not proceed until satisfactory conditions are achieved.

B. Inspect conditions of substrate and other conditions which may affect installation of signage.

C. Do not begin installation until substrates are within manufacturer’s specified tolerances and have been prepared in accordance with manufacturer’s instructions.

D. If substrate preparation is the responsibility of another installer, do not proceed with installation. Notify Architect of unsatisfactory preparation immediately.
3.2 PREPARATION

A. Verify mounting heights and locations for signage will comply with specified requirements, including accessibility requirements.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions. Clean mounting locations of dirt, dust, grease or similar conditions that would prevent proper installation.

3.3 INSTALLATION

A. Install in accordance with manufacturer's printed installation instructions, and in proper relationship with adjacent work. Use mounting methods and fasteners as recommended by manufacturer. Set level, plumb, rigid and at heights indicated with surfaces free from defects.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 10 14 00
SECTION 10 14 19 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

   A. Section Includes:

      1. Cast dimensional characters.
      2. Cutout dimensional characters.

1.3 ACTION SUBMITTALS

   A. Product Data: For each type of product.

   B. Sustainable Design Submittals:

      1. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
      2. Product Data: For adhesives, indicating VOC content.
      3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

   C. Shop Drawings: For dimensional letter signs.

      1. Include fabrication and installation details and attachments to other work.
      2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
      3. Show message list, typstyles, graphic elements, and layout for each sign at least half size.
      4. Show locations of electrical service connections.
      5. Include diagrams for power, signal, and control wiring.

   D. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

      1. Include representative Samples of available typstyles and graphic symbols.

   E. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer’s standard size unless otherwise indicated and as follows:

      1. Dimensional Characters: Full-size Sample of each type of dimensional character.
      2. Exposed Accessories: Full-size Sample of each accessory type.
F. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Deterioration of finishes beyond normal weathering.
   b. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DIMENSIONAL LETTER SIGNS, GENERAL

A. **Regional Materials**: Products shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Regional Materials: Products shall be manufactured within 500 miles (800 km) of Project site.

2.2 DIMENSIONAL CHARACTERS

A. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:

1. **Manufacturers**: Subject to compliance with requirements, provide products by one of the following:
DIMENSIONAL LETTER SIGNAGE

   b. ASI Sign Systems, Inc.
   c. Gemini Incorporated.

2. Character Material: Cast aluminum.

3. Character Height: As indicated.

4. Thickness: As indicated.

5. Finishes:
   a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
   b. Integral Aluminum Finish: Clear anodized.

6. Mounting: As indicated.

7. Typeface: As indicated on drawings.

B. Cutout Characters: Characters with uniform faces; square-cut, smooth edges; precisely formed lines and profiles; and as follows:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. ASI Sign Systems, Inc.
   c. Gemini Incorporated.
   d. InPro Corporation (IPC).

2. Character Material: Sheet or plate aluminum.

3. Character Height: As indicated.

4. Thickness: As indicated.

5. Finishes:
   a. Integral Aluminum Finish: Clear anodized.

6. Mounting: As indicated - Adhesive

7. Typeface: As indicated

2.3 DIMENSIONAL CHARACTER MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.

B. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer’s standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:
   a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
   b. Fastener Heads: For nonstructural connections, use flathead screws and bolts with tamper-resistant Allen-head slots unless otherwise indicated.

4. Sign Mounting Fasteners:
   a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
   b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.

B. Adhesive: As recommended by sign manufacturer.
   1. **Adhesives shall have a VOC content of [70]** [Insert value] g/L or less.
   2. **Adhesive shall comply with the** testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
   1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
   2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
   3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
   4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
   5. Internally brace signs for stability and for securing fasteners.
   6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
   7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that electrical service is correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:
1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
   a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
   b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
   a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
   b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.

3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.

4. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.

5. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.

6. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 14 19
SECTION 10 14 23 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Panel signs.
2. Room-identification signs.
3. Field-applied, vinyl-character signs.

1.3 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.
B. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.4 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Sustainable Design Submittals:
   1. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
C. Shop Drawings: For panel signs.
   1. Include fabrication and installation details and attachments to other work.
   2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
   3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
D. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
1. Include representative Samples of available typestyles and graphic symbols.

E. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer’s standard size unless otherwise indicated and as follows:

1. Panel Signs: Full-size Sample.
2. Room-Identification Signs: Full-size Sample.
4. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
5. Exposed Accessories: Full-size Sample of each accessory type.

F. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Deterioration of finishes beyond normal weathering.
   b. Deterioration of embedded graphic image.
   c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1  PERFORMANCE REQUIREMENTS

A.  Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board’s ADA-ABA Accessibility Guidelines for Buildings and Facilities for signs.

2.2  SIGNS

A.  Basis-of-Design Product: Subject to compliance with requirements, provide Mohawk Sign Systems; or a comparable product by one of the following:

1.  ASI Sign Systems, Inc.
2.  Best Sign Systems, Inc.
3.  InPro Corporation (IPC).

B.  Building Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1.  Basis-of-Design Product: To match existing university signage at adjacent buildings. Manufacture and Install Basis of Design: Campus ID monument sign with brick base: 3'-3" x 6'-0" x 6'-0" OAD Ornamental Topper. Snyder Signs Inc.

2.  Solid-Sheet Sign and Returns, Returns, and Back: Aluminum sheet with finish specified in "Surface Finish and Applied Graphics" Subparagraph below and as follows:

   a.  Thickness: per campus standards
   b.  Inset, Cutout Characters: Sign face routed to receive push-through acrylic graphics slightly projecting from the sign panel.

C.  Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

2.  Laminated-Sheet Sign: Sandblasted polymer face sheet with raised graphics on phenolic backing sheet to produce composite sheet.

   a.  Composite-Sheet Thickness: Manufacturer's standard for size of sign.
   b.  Color(s): per ETSU Design Standard and as selected by Architect from manufacturer's full range


   a.  Edge Condition: Square cut.
   b.  Corner Condition in Elevation: 3/4" Radius.

5. Text and Typeface: Accessible raised characters and Braille typeface matching Architect's sample and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 FIELD-APPLIED, VINYL-CHARACTER SIGNS

A. Field-Applied, Vinyl-Character Sign: Prespaced characters die cut from 3- to 3.5-mil thick, weather-resistant vinyl film with release liner on the back and carrier film on the front for on-site alignment and application.

B. Manufacturers:
   1. 3M
   2. Others as preapproved in advance by Architect

C. Size: to be determined

D. Substrate: Glass, Doors and / or Walls

E. Text and Font: to be determined

2.4 PANEL-SIGN MATERIALS

A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

B. Plastic-Laminate Sheet: NEMA LD 3, general-purpose HGS grade, 0.048-inch (1.2-mm) nominal thickness.

C. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated and suitable for exterior applications.

D. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.5 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:
   a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
   b. Fastener Heads: For nonstructural connections, use flathead screws and bolts with tamper-resistant Allen-head slots unless otherwise indicated.

4. Sign Mounting Fasteners:
Panel Signage

5. Inserts: Furnish inserts to be set by other trades into concrete or masonry work.

B. Adhesive: As recommended by sign manufacturer.

1. Adhesives shall have a VOC content of 70 g/L or less.

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

D. Hook-and-Loop Tape: Manufacturer's standard two-part tape consisting of hooked part on sign back and looped side on mounting surface.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 Fabrication

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.

2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.

4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.

5. Internally brace signs for stability and for securing fasteners.

6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into panel surface indicated to produce precisely formed copy, incised to uniform depth.

1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.

2. Engraved Opaque Acrylic Sheet: Fill engraved graphics with manufacturer's standard enamel.


4. Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.
C. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.

D. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:

1. For snap-in changeable inserts beneath removable face sheet, furnish one suction or other device to assist in removing face sheet. Furnish initial changeable insert. Subsequent changeable inserts are by Owner.
2. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Subsequent changeable inserts are by Owner.
3. For frame to hold changeable sign panel, fabricate frame without burrs or constrictions that inhibit function. Furnish initial sign panel. Subsequent changeable sign panels are by Owner.

E. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer’s standard brackets as required.

1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match sign-background color unless otherwise indicated.
2. Stainless-Steel Brackets: Factory finish brackets with No. 4 finish unless otherwise indicated.

2.7 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that anchor inserts are correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls as indicated and according to accessibility standard.

C. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
   a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
   b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
   a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
   b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.

3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.

4. Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.

5. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.

6. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign.
7. Shim-Plate Mounting: Provide 1/8-inch- (3-mm-) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other direct mounting methods are impractical. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach signs to plate using method specified above.


E. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 14 23
SECTION 10 21 23 - CUBICLE CURTAINS AND TRACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
   1. Ceiling mounted curtain track
   2. Track accessories and attachments
   3. Cubicle curtains

B. Related Requirements:
   1. Division 09 51 23 Section "Acoustic Tile Ceilings" for attachment of track to acoustic ceiling grid.

1.3 DEFINITIONS

1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer’s product data sheets for all specified curtain track and curtains.

B. Shop Drawings:
   1. Include plans, elevations, sections, and mounting and attachment details.

C. Samples for Verification: Provide samples of the following:
   1. Samples of cubicle track, 4-inches in length. Complete with (1) carrier as specified and stop.
   2. Curtain Fabric: 12-inch square swatch or larger sample as required showing complete pattern repeat, from dye lot used for the work, with specified treatments applied.
   3. Mesh Top: Not less than 4-inches square, demonstrating manufacturer’s standard hemming around mesh perimeter with matching fabric.

D. Manufacturer’s standard installation instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in unopened factory packaging.

B. Inspect material on delivery to verify products are as specified.
1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: 1 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide C/S Cubicle Curtains, (908) 849-4000, www.c-sgroup.com; surface mounted tracks, carriers, and curtains or comparable products by other manufacturers with prior approval of Architect.

2.2 CUBICLE TRACK SYSTEM

A. Cubicle Tracks: C/S Cubicle Curtains #6062 (or approved equal) surface mounted tracks of heavy extruded aluminum alloy 60630T4, 1-3/8-inches by 3/4-inches, slotted to receive roller carriers, complete with accessories and components required for complete and secure installations including splices, end caps and corner bends.

B. Corner Bends: Corner bends up to 36-inch radius are to be fabricated in one continuous “L” shape. Radii above 36-inches to be continuous or spliced based on room condition.

1. Finish to be selected by Architect from manufacturer’s full range of selections.

C. Carriers:

1. C/S Cubicle Curtains 1062N (or approved equal), virgin nylon axle with nylon wheels complete with nickel-plated brass bead-chain and hook assembly.

a. Provide one carrier for each 6-inch of cubicle curtain width.

2.3 CUBICLE CURTAINS

A. Cubicle Curtain Fabric: Provide 100% polyester curtains. Fabric is to be opaque, washable, flame retardant and closely woven.

B. Pattern & Color: To be selected by Architect from manufacturer’s full range of available selections.

C. Antimicrobial Treatment:

1. Standard antimicrobial treatment applied to the selected cubicle curtain fabric.

2.4 FABRICATION

A. Cubicle Curtain

1. Type of C/S Curtain (or approved equal):

a. C/S Traditional Curtains (or approved equal).
2. Width: Equal to track length from which curtain is hung plus 10 percent, but not less than 12-inches.
3. Length: Equal to floor-to-ceiling height minus 2-inches from finished ceiling at top and 12-inches above finished floor.
4. Mesh Top: Manufacturer’s standard 1/2-inch holed mesh top, framed around perimeter with matching fabric as specified. Mesh height to be 18-inches.
5. Top Hem: Not less than 1-inch and not more than 1-1/2-inch wide, triple thickness, reinforced with integral web and double stitched.
   a. Grommets: 2 piece, rolled-edge, rustproof, nickel-plated brass and spaced not more than 6-inches o.c.
6. Bottom and Side Hems: Not less than 1-inch wide, reinforced, triple thickness and single stitched.
7. Curtain Tieback: At each termination.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. Complete all finishing operations, including painting, before beginning installation of cubicle tracking system materials.
   2. Verify that surfaces and above ceiling supports are ready to receive work.

3.2 INSTALLATION

A. General: Locate the cubicle track as indicated on the approved detail drawing for the appropriate substrate.

B. Installation of Cubicle Track System:
   1. Install cubicle track, secure, rigid, and true to ceiling line.
   2. Slide carriers onto the track.
   3. Install end cap or stop device.
   4. Secure or suspend track to ceiling system. Install with mechanical fasteners or T-Grid clips.
   5. Install curtains on carriers ensuring smooth operation.

3.3 CLEANING

A. At completion of the installation, remove any debris and clean surfaces in accordance with manufacturer’s cleaning and maintenance instructions.

END OF SECTION 10 21 23
SECTION 10 22 39 - FOLDING PANEL PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
   1. Manually operated, acoustical panel partitions.
B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
   2. Section 092900 "Gypsum Board" for fire-rated assemblies and sound barrier construction above the ceiling at track.

1.3 DEFINITIONS
A. NIC: Noise Isolation Class.
B. NRC: Noise Reduction Coefficient.
C. STC: Sound Transmission Class.

1.4 PREINSTALLATION MEETINGS
A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Sustainable Design Submittals:
   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
   3. Chain-of-Custody Qualification Data: For manufacturer and vendor.
4. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.
5. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For operable panel partitions.
   1. Include plans, elevations, sections, details, numbered panel installation sequence, and attachments to other work.
   2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
   3. Include diagrams for power, signal, and control wiring.

D. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.
   1. Include Samples of accessories involving color selection.

E. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:
   1. Panel Facing Material: Manufacturer's standard-size unit, not less than 3 inches (75 mm) square.
   2. Panel Edge Material: Not less than 3 inches (75 mm) long.
   3. Chair Rail: Manufacturer's standard-size unit, 6 inches (150 mm) long.
   4. Glass: Units 12 inches (300 mm) square.
   5. Hardware: One of each exposed door-operating device.

F. Delegated-Design Submittal: For operable panel partitions.
   1. Include design calculations for seismic restraints.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Partition track, track supports and bracing, switches, turning space, and storage layout.
   2. Suspended ceiling components.
   3. Structural members to which suspension systems are attached.
   4. Size and location of initial access modules for acoustical tile.
   5. Items penetrating finished ceiling, including the following:
      a. Lighting fixtures.
      b. HVAC ductwork, outlets, and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Smoke detectors.
      f. Access panels.
   6. Plenum acoustical barriers.

B. Setting Drawings: For embedded items and cutouts required in other work
C. Qualification Data: For qualified Installer.

D. Seismic Qualification Certificates: For operable panel partitions, tracks, accessories, and components, from manufacturer. Include seismic capacity of partition assemblies to remain in vertical position during a seismic event and the following:

1. Basis for Certification: Indicate whether certification is based on analysis, testing, or experience data, according to ASCE/SEI 7.
2. Detailed description of partition anchorage devices on which the certification is based and their installation requirements.

E. Product Certificates: For each type of operable panel partition.

1. Include approval letter signed by manufacturer acknowledging Owner-furnished panel facing material complies with requirements.

F. Product Test Reports: For each operable panel partition, for tests performed by a qualified testing agency.

G. Field quality-control reports.

H. Sample Warranty: For manufacturer's special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.

1. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
2. Seals, hardware, track, track switches, carriers, and other operating components.
3. Electric operator and controls.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
D. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.

E. The partition STC (Sound Transmission Classification) shall be achieved per the standard test methods ASTM E90.

F. Noise isolation classifications shall be achieved per the standard test methods ASTM E336 and ASTM E413.

G. Noise Reduction Coefficient (NRC) ratings shall be per ASTM C423.

H. Rack testing for 10 years. (tensile strength stress test)

I. The manufacturer shall have a quality system that is registered to the ISO 9001 standards.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Faulty operation of operable panel partitions.
   b. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic bracing of tracks to structure above.

B. Seismic Performance: Operable panel partitions shall withstand the effects of earthquake motions determined according to those indicated on structural drawings.

   1. The term "withstand" means "the partition panels will remain in place without separation of any parts from the system when subjected to the seismic forces specified."

C. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.

2. Noise-Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C 423, and rated for not less than the NRC indicated.

3. Noise-Isolation Requirements: Installed operable panel partition assembly, identical to partition tested for STC, tested for NIC according to ASTM E 336, determined by ASTM E 413, and rated for 10 dB less than STC value indicated.

D. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol.

E. Fire Resistance: Provide fire-rated operable panel partition assemblies complying with NFPA 80, based on testing according to UL 10B for fire-rated door assemblies.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

2. Pass doors in fire-rated operable panel partition assemblies shall meet positive-pressure requirements.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 OPERABLE ACOUSTICAL PANELS

A. Operable Acoustical Panels: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Hufcor, Inc; Series 632 or a comparable product by one of the following:
   a. Moderco Inc.
   b. Modernfold, Inc.
   c. Panelfold Inc.

B. Panel Operation: Manually operated, individual panels.
C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.

1. Panel Width: Equal widths.

E. STC: Not less than 41.

F. Panel Weight: 8 lb/sq. ft. (40 kg/sq. m) maximum.

G. Panel Thickness: Not less than 3 inches (75 mm).

H. Panel Materials:

1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
3. Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
5. Steel Face/Liner Sheets: Tension-leveled steel sheet, manufacturer's standard minimum nominal thickness for uncoated steel.
6. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; ASTM B 221 (ASTM B 221M) for extrusions; manufacturer's standard strengths and thicknesses for type of use.
   a. Frame Reinforcement: Manufacturer's standard steel or aluminum.
7. Gypsum Board: ASTM C 1396/C 1396M.

I. Panel Closure: Manufacturer's standard unless otherwise indicated.

J. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.

1. Hinges: Manufacturer's standard.
2.3 SEALS

A. General: Provide seals that produce operable panel partitions complying with performance requirements and the following:

1. Manufacturer's standard seals unless otherwise indicated.
2. Seals made from materials and in profiles that minimize sound leakage.
3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.

B. Vertical Seals: Deep-nesting, interlocking astragals mounted on each edge of panel, with continuous PVC acoustical seal.

C. Horizontal Top Seals: Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track.

D. Horizontal Bottom Seals: Manufacturer's standard continuous-contact seal exerting uniform constant pressure on floor.

E. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.

1. Mechanically Operated for Acoustical Panels: Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range not less than 2 inches (50 mm) between retracted seal and floor finish.

2.4 PANEL FINISH FACINGS

A. General: Provide finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.

1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with invisible seams complying with Shop Drawings for location, and with no gaps or overlaps. Horizontal butted edges or seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
   a. Dry erase markerboard. Color to be selected by Architect from manufacturer's full range of selections.

2. Where facings with directional or repeating patterns or directional weave are indicated, mark facing top and attach facing in same direction.

3. Match facing pattern 72 inches (1830 mm) above finished floor.

B. Presentation facing as indicated below.

C. Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing, finished as follows:

1. Aluminum: Finished with manufacturer's standard clear anodic finish.
D. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.

2.5 SUSPENSION SYSTEMS

A. Tracks: Steel or aluminum mounted directly to overhead structural support, designed for operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch (2.54 mm) between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.

1. Panel Guide: Aluminum guide on both sides of the track to facilitate straightening of the panels; finished with factory-applied, decorative, protective finish.

2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.

B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.

1. Multidirectional Carriers: Capable of negotiating intersections without track switches.

C. Track Intersections, Switches, and Accessories: As required for operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.

1. Curve-and-Diverter Switches: Allow radius turns to divert panels to an auxiliary track.

2. L Intersections: Allow panels to change 90 degrees in direction of travel.

3. T Intersections: Allow panels to pass through or change 90 degrees to another direction of travel.

4. X Intersections: Allow panels to pass through or change travel direction full circle in 90-degree increments, and allow one partition to cross track of another.

5. Multidirectional Switches: Adjustable switch configuring track into L, T, or X intersections and allowing panels to be moved in all pass-through, 90-degree change, and cross-over travel direction combinations.

6. Center carrier stop.

D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.

E. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

2.6 PRE-ENGINEERED STRUCTURAL SUPPORT

A. Basis of Design: Hufcor Series U900 Unispan including truss and post supports

1. Unfinished for field finishing within gypsum board bulkhead.
2.7 ACCESSORIES

A. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with operating hardware and acoustical seals at soffit, floor, and jambs. Hinges in finish to match other exposed hardware.

1. Manufacturer's standard method to secure storage pocket door in closed position.
2. Rim Lock: Key-operated lock cylinder to secure storage pocket door in closed position. Include two keys per lock.
3. Rim Lock: Deadlock to receive cylinder, to secure storage pocket door in closed position. See Section 087100 "Door Hardware" for lock cylinder and keying requirements.

B. Work Surfaces: Quantities, placement, and size indicated.

2. Surface Color: As selected by Architect from manufacturer's full range.
3. Size: Full width and height of panel.
4. Trim: Aluminum slip-on or snap-on trim with no visible screws or exposed joints and with corners mitered to a neat, hairline joint.

C. Chalk Tray and Eraser Pocket: Aluminum with clear anodic finish.

D. Chair Rails: . Surface mounted in locations indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.

B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.

C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.

D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.
F. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals. Perform test and make adjustments before NIC testing.

3.3 ADJUSTING

A. Adjust operable panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust storage pocket doors to operate smoothly and easily, without binding or warping.

C. Verify that safety devices are properly functioning.

3.4 CLEANING

A. All track and panel surfaces shall be wiped clean and free of handprints, grease, and soil.

B. Cartoning and other installation debris shall be removed to onsite waste collection area, provided by others.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION 10 22 39
SECTION 10 41 16 – KNOX BOX

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. This Section includes the following:
   1. Fire Department Knox Box.
B. Related Sections include the following:
   1. Division 4 Section “Brick Masonry”.
   2. Division 4 Section “Concrete Unit Masonry”.

1.3 SUBMITTALS
A. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, required clearances, components, and location and size of each field connection.
B. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.
C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available.

1.4 DELIVERY, STORAGE AND HANDLING
A. Examine units upon arrival at job site. Notify the carrier and manufacturer of any damage immediately.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Available Manufacturers:
   1. Knox Company: 3200 Series
      a. 1601 W. Deer Valley Road / Phoenix, AZ 85027
      b. Ph: 800.552.5669 / Fax: 623.687.2299
   2. Or approved equal.
2.2 KNOX BOX

A. Knox Box: Surface mounted with hinged door, with UL Listed tamper switches. 1/4” plate steel housing, 1/2” thick steel door with interior gasket seal and stainless steel door hinge. Box and lock UL Listed. Lock has 1/8” thick stainless steel dust cover with tamper seal mounting capability.
   1. Exterior Dimensions:
      a. Surface mount body: 4” high x 5” wide x 3-1/4” deep
   3. Finish: Knox-coat finishing process with additional rust and corrosion protection.
   4. Color: Aluminum
   5. P/N: 3200 Series KNOX-BOX
   6. Contractor to verify keying through Owner and fire authority having jurisdiction prior to ordering.

B. Key Switch: Coordinate with Electrical. Surface mounted with hinged door, with UL Listed tamper switches. 1/4” plate steel housing, 1/2” thick steel door with interior gasket seal and stainless steel door hinge. Box and lock UL Listed. Lock has 1/8” thick stainless steel dust cover with tamper seal mounting capability.
   1. Exterior Dimensions:
      a. Surface mount body: 4” high x 5” wide x 3-1/4” deep (verify)
   3. Finish: Knox-coat finishing process with additional rust and corrosion protection.
   4. Color: Aluminum/Stainless
   5. P/N: 3502 Series KNOX-Key Switch – Single Switch
   6. Contractor to verify keying through Owner and fire authority having jurisdiction prior to ordering.

2.3 ACCESSORIES

A. Provide an Alarm Tamper Switch (UL Listed).

B. Provide all accessories and parts for a complete installation. Coordinate with electrical and fire alarm contractor to provide secure and properly wired installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install per manufacturer’s recommendations for a secure installation.

B. Take care to make sure that the front of the shell housing, including cover plate and screw heads, are flush with the finish wall. Leave cover and screws in place until the KNOX-BOX is ready for mounting inside.

C. Do not over tighten mounting bolts as this will distort the flange.

D. When the KNOX-BOX includes a door tamper switch, install the tamper switch assembly after the box is mounted. Pull the wire tight so that any attempts to force the box out of the wall will break the wire or pull the terminals loose. A qualified alarm installer should perform alarm wiring, testing, and adjusting.

E. Connect tamper switch wires to building’s alarm system.
SECTION 10 44 13 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

   a. Portable fire extinguishers.
   b. Fire hose valves.
   c. Fire hoses and racks.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

1. Show location of knockouts for hose valves.

B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

D. Samples for Initial Selection: For each type of exposed finish required.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples 6 by 6 inches (150 by 150 mm) square.

F. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.
1.4 CLOSEOUT SUBMITTALS
   A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.5 COORDINATION
   A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers, fire hoses, hose valves, and hose racks indicated are accommodated.
   B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

1.6 SEQUENCING
   A. Apply decals on field-painted fire-protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
   B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FIRE-PROTECTION CABINET
   A. Cabinet Type: Suitable for fire extinguisher
      1. Basis-of-Design Product: Subject to compliance with requirements, provide JL Industries, Inc.; a division of the Activar Construction Products Group; or a comparable product by one of the following:
         a. American Specialties, Inc.
         b. Guardian Fire Equipment, Inc.
         c. Kidde Residential and Commercial Division.
         d. Larsens Manufacturing Company.
         e. Modern Metal Products, Division of Technico Inc.
   B. Cabinet Construction: to match wall rating where indicated on drawings.
      1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch-(1.09-mm-) thick cold-rolled steel sheet lined with minimum 5/8-inch-(16-mm-) thick fire-barrier material. Provide factory-drilled mounting holes.
   C. Cabinet Material: Aluminum sheet.
1. Shelf: Same metal and finish as cabinet.

D. Recessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
   1. Square-Edge Trim: Trimless.

E. Cabinet Trim Material: Aluminum sheet.

F. Door Material: Aluminum sheet.

G. Door Style: Full acrylic bubble, frameless.

H. Door Glazing: Molded acrylic bubble.
   1. Acrylic Sheet Color: Clear transparent acrylic sheet.

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
   1. Provide projecting door pull and friction latch.
   2. Provide concealed hinge permitting door to open 180 degrees.

J. Accessories:
   1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
   2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
   3. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.

K. Materials:
   1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
      a. Finish: Baked enamel or powder coat.
      b. Color: As selected by Architect from full range of industry colors and color densities.
   2. Aluminum: ASTM B 221 (ASTM B 221M), with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet. ASTM B 221 (ASTM B 221M) for extruded shapes.
      a. Finish: Color anodic.
      b. Color: As selected by Architect from full range of industry colors and color densities.
   3. Stainless Steel: ASTM A 666, Type 304.
      a. Finish: No. 4 directional satin finish
   4. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).
5. **Break Glass:** Clear annealed float glass, ASTM C 1036, Type I, Class 1, Quality q3, 1.5 mm thick, single strength.
6. **Tempered Break Glass:** ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.
7. **Wire Glass:** ASTM C 1036, Type II, Class 1, Form 1, Quality q8, Mesh m1 (diamond), 6 mm thick.
8. **Transparent Acrylic Sheet:** ASTM D 4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

### 2.3 FABRICATION

**A. Fire-Protection Cabinets:** Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.
4. Install door locks at factory.

**B. Cabinet Doors:** Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames.

**C. Cabinet Trim:** Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

### 2.4 GENERAL FINISH REQUIREMENTS

**A.** Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

**B.** Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

**C.** Finish fire-protection cabinets after assembly.

**D.** Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

### PART 3 - EXECUTION

### 3.1 EXAMINATION

**A.** Examine roughing-in for hose valves racks and cabinets to verify actual locations of piping connections before cabinet installation.
B. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below: or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Fire-Protection Cabinets: 48 inches (1372 mm) above finished floor to top of cabinet.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
4. Fire-Rated Hose and Valve Cabinets:
   a. Install cabinet with not more than 1/16-inch (1.6-mm) tolerance between pipe OD and knockout OD. Center pipe within knockout.
   b. Seal through penetrations with firestopping sealant as specified in Section 078413 "Penetration Firestopping."

C. Identification: Apply vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer’s written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
SECTION 10 44 16 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section includes portable, fire extinguishers and mounting brackets for fire extinguishers.
   B. Related Requirements:
      1. Section 104413 "Fire Protection Cabinets."

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
   B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS
   A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 COORDINATION
   A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY
   A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
      1. Failures include, but are not limited to, the following:
a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, “Portable Fire Extinguishers.”

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Guardian Fire Equipment, Inc.
   b. JL Industries, Inc.; a division of the Activar Construction Products Group.
   c. Larsens Manufacturing Company.

2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Type FE (R) and Type FE (B) as shown on Drawings
   1. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

C. Type FE (B) in Room 107
   1. Class K Wet Chemical Type: Extinguisher unit containing a low “pH” potassium acetate solution.
      a. Construction: Stainless steel cylinder with protective nozzle tip orifice seal and nonmetallic nozzle tip finger guard, O-ring seal, replaceable valve stem seal, visual pressure gage, pull pin, and upright squeeze grip.
      b. Effectiveness (Rating): Class K fires.

2.3 MOUNTING BRACKETS

A. Type FE (B)
1. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

2. **Manufacturers**: Subject to compliance with requirements, provide products by one of the following:
   a. [Guardian Fire Equipment, Inc.](#)
   b. [JL Industries, Inc.; a division of the Activar Construction Products Group](#)
   c. [Larsens Manufacturing Company](#)

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
   1. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416
SECTION 10 51 13 - METAL LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal lockers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of metal locker.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.

B. Shop Drawings: For metal lockers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Show locker trim and accessories.
3. Include locker identification system and numbering sequence.

C. Samples: For each color specified, in manufacturer's standard size.

D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available.

E. Samples for Verification: For the following products, in manufacturer's standard size:

1. Lockers and equipment

F. Product Schedule: For lockers.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.
1.5 CLOSEOUT SUBMITTALS
   A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS
   A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
      1. Full-size units of the following metal locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than five units:
         a. Locks.
         b. Identification plates.
         c. Hooks.

1.7 DELIVERY, STORAGE, AND HANDLING
   A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.
   B. Deliver combination control charts to Owner by registered mail or overnight package service.
      1. See Owner representative contact information in Section 00 00 02 Project Directory.

1.8 FIELD CONDITIONS
   A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.9 COORDINATION
   A. Coordinate sizes and locations of bases for metal lockers.
   B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.10 WARRANTY
   A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
      1. Failures include, but are not limited to, the following:
         a. Structural failures.
         b. Faulty operation of latches and other door hardware.
2. Damage from deliberate destruction and vandalism is excluded.
3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.
4. Warranty Period for Welded Metal Lockers: Lifetime from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain metal lockers, locker benches, and accessories from single source from single locker manufacturer.

1. Obtain locks from single lock manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Requirements: For lockers indicated to be accessible, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board’s ADA-ABA Accessibility Guidelines.

2.3 KNOCKED-DOWN CORRIDOR LOCKERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Republic Storage Systems, LLC; “Standard” or a comparable product by one of the following:

1. ASI Storage Solutions; ASI Group.
2. Hadrian Manufacturing Inc.
3. Penco Products, Inc.

B. Doors: One piece; fabricated from 0.060-inch min. nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

1. Doors less than 12 inches (305 mm) wide may be fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
2. Doors for box lockers less than 15 inches (381 mm) wide may be fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.
3. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.
4. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet; welded to inner face of doors.
5. Sound-Dampening Panels: Manufacturer's standard, designed to stiffen doors and reduce sound levels when doors are closed, of die-formed metal with full perimeter flange and sound-dampening material; welded to inner face of doors.
6. Door Style: Unperforated panel.
   a. Louvered Vents: No fewer than three louver openings at top and bottom for double-tier lockers.
C. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops, Bottoms, and Intermediate Dividers: 0.024-inch (0.61-mm) nominal thickness, with single bend at sides.
2. Backs and Sides: 0.024-inch (0.61-mm) nominal thickness, with full-height, double-flanged connections.
3. Shelves: 0.024-inch (0.61-mm) nominal thickness, with double bend at front and single bend at sides and back.

D. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
2. Frame Vents: Fabricate face frames with vents.

E. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.

1. Continuous Hinges: Manufacturer's standard, steel, full height.

F. Projecting Door Handle and Latch: Finger-lift latch control designed for use with either built-in combination locks or padlocks; positive automatic latching, chromium plated; pry and vandal resistant.

1. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.105-inch (2.66-mm) nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
2. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
3. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic latching and prelocking.
   a. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.105-inch (2.66-mm) nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
   b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.
4. Single-Point Latching: Nonmoving latch hook designed to engage bolt of built-in combination or cylinder lock.
a. Latch Hook: Equip each door with one latch hook, fabricated from 0.105-inch (2.66-mm) nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.

G. Door Handle and Latch for Box Lockers: Stainless-steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.

H. Locks: Digital keypad locks.

I. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch (9 mm) high.

J. Hooks: Manufacturer's standard ball-pointed type hooks, aluminum or steel; zinc plated.


L. Coat Rods: 3/4-inch- (19-mm-) diameter steel tube or rod, chrome finished.

M. Continuous Zee Base: Fabricated from manufacturer's standard thickness, but not less than 0.060-inch (1.52-mm) nominal-thickness steel sheet.
   1. Height: 4 inches (102 mm).

N. Continuous Sloping Tops: Fabricated from manufacturer's standard thickness, but not less than 0.036-inch (0.91-mm) nominal-thickness steel sheet.
   2. Sloping-top corner fillers, mitered.

O. Individual Sloping Tops: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet.

P. Recess Trim: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

Q. Filler Panels: Fabricated from manufacturer's standard thickness, but not less than 0.036-inch (0.91-mm) nominal-thickness steel sheet.

R. Boxed End Panels: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet.

S. Center Dividers: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet.

T. Materials:
   1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
   2. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with A60 (i F180) zinc-iron, alloy (galvannealed) coating designation.

U. Finish: Baked enamel or powder coat.
   1. Color: As selected by Architect from manufacturer's full range.
2.4 LOCKS

A. Manufacturers:
   1. Digilock
   2. Zephyr Lock LLC
   3. Other manufacturers complying with Basis of Design Digilock.

B. Digital Keypad Locks: Battery-powered electronic keypad with reprogrammable manager and owner codes that override access. Three consecutive incorrect code entries shall disable lock for three minutes.
   1. Designed for shared or temporary access by multiple users, with user-defined code to lock and unlock. Provide LED indicator to show when lock is in use.

2.5 FABRICATION

A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
   1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
   2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.

C. Equipment: Provide each locker with an identification plate and the following equipment:
   1. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
   2. Coat Rods: For each compartment of each locker.

D. Knocked-Down Construction: Fabricate metal lockers using nuts, bolts, screws, or rivets for preassembly at plant prior to shipping.

E. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.

F. Accessible Lockers: Fabricate as follows: (all lower tier lockers shall meet this requirement)
   1. Locate bottom shelf no lower than 15 inches (381 mm) above the floor.
   2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches (1219 mm) above the floor.

G. Continuous Base: Formed into channel or zee profile for stiffness, and fabricated in lengths as long as practical to enclose base and base ends of metal lockers; finished to match lockers.

H. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.
   1. Sloping-top corner fillers, mitered.
I. Individual Sloping Tops: Fabricated in width to fit one locker frame in lieu of flat locker tops; with integral back; finished to match lockers. Provide wedge-shaped divider panels between lockers.

J. Recess Trim: Fabricated with minimum 2-1/2-inch (64-mm) face width and in lengths as long as practical; finished to match lockers.

K. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

L. Boxed End Panels: Fabricated with 1-inch- (25-mm-) wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.
   1. Provide one-piece panels for double-row (back-to-back) locker ends.

M. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

2.6 ACCESSORIES

A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.

B. Anchors: Material, type, and size required for secure anchorage to each substrate.
   1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls, and elsewhere as indicated, for corrosion resistance.
   2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install lockers level, plumb, and true; shim as required, using concealed shims.
   1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
   2. Anchor single rows of metal lockers to walls near top and bottom of lockers of lockers and to floor.
   3. Anchor back-to-back metal lockers to floor.
B. Knocked-Down Lockers: Assemble with standard fasteners, with no exposed fasteners on door faces or face frames.

C. Welded Lockers: Connect groups together with standard fasteners, with no exposed fasteners on face frames.

D. Equipment:
   1. Attach hooks with at least two fasteners.
   2. Attach door locks on doors using security-type fasteners.
   3. Identification Plates: Identify metal lockers with identification indicated on Drawings.
      a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
      b. Attach plates to upper shelf of each open-front metal locker, centered, with at least two aluminum rivets.

E. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
   1. Attach recess trim to recessed metal lockers with concealed clips.
   2. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
   3. Attach sloping-top units to metal lockers, with closures at exposed ends.
   4. Attach boxed end panels using concealed fasteners to conceal exposed ends of nonrecessed metal lockers.
   5. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

3.3 ADJUSTING
A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.

3.4 PROTECTION
A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105113
SECTION 12 36 61.19 - QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
   1. Quartz agglomerate countertops.
   2. Quartz agglomerate backsplashes.

1.3 ACTION SUBMITTALS
A. Product Data: For countertop materials.
B. Sustainable Design Submittals:
   1. Product Data: For adhesives, indicating VOC content.
   2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
C. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
   1. Show locations and details of joints.
   2. Show direction of directional pattern, if any.
D. Samples for Verification: For the following products:
   1. Countertop material, 6 inches (150 mm) square.

1.4 INFORMATIONAL SUBMITTALS
A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS
A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.
1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
   1. Build mockup of typical countertop as shown on Drawings.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.8 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.

B. Designed per Manufacturer: Cambria (www.cambriausa.com ) or architect approved equal from following manufacturers:
   1. Wilsonart - www.wilsonart.com
   2. Silestone - www.silestoneusa.com

C. Colors and Patterns: As indicated on finish schedule/drawings.

D. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."
   1. Grade: Premium.

B. Configuration:
1. Front: Straight, slightly eased at top
2. Backsplash: Straight, slightly eased at corner
3. End Splash: Straight, slightly eased at corner.

C. Countertops: 3/4-inch thick, quartz agglomerate with front edge built up with same material.

D. Backsplashes & Sidesplashes: 1/2-inch thick, quartz agglomerate

E. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
1. Fabricate with loose backsplashes for field assembly.

F. Joints: Fabricate countertops in sections for joining in field
1. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
2. Joint Type: Bonded, 1/32 inch (0.8 mm) or less in width.
3. Joint Type: Sealant filled, 1/16 inch (1.5 mm) in width.

G. Cutouts and Holes:
1. Undercounter Plumbing Fixtures: Make cutouts for fixtures using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
   a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch (5 mm) into fixture opening.
   3. Fittings: Drill countertops in shop for plumbing fittings and similar items.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by quartz agglomerate manufacturer.
1. Adhesives shall have a VOC content of [70] \textless Insert value\textgreater g/L or less.
2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

C. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
   1. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

F. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 12 36 61.19
SECTION 13 20 00 – CLEAN ROOM PASS THRU CAB

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Clean Room Pass-Through Chambers and accessories

1.2 REFERENCES


B. ASTM A 666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.


F. CAN/ULC-S104-10 - Standard Method for Fire Tests of Door Assemblies

G. FS 209E - Cleanroom and Workstation Requirements, Controlled Environments.

H. ISO 146744-1 - Cleanrooms and associated controlled environments Part 1: Classification of air cleanliness

I. UL (Underwriters Laboratories, Inc.) - Electrical Appliance and Utilization Equipment Directory.

J. FDA/cGMP Requirements - 21 CFR Section 211 and Proposed Guidelines 21 CFR Section 212.

1.3 DESIGN / PERFORMANCE REQUIREMENTS

A. Cleanroom Pass Through shall be capable of maintaining the following cleanroom performance requirements when installed as follows.

1. Capable of maintaining Class 100 to 10,000 (ISO 5 to ISO 8) conditions in accordance with FS 209E and ISO 146744-1.

2. Capable of meeting validation requirements of FDA/cGMP and the following requirements.
   a. Nonviability Particle Count: Maximum of 10,000 per cf, 0.5 micron or larger measured 6 inches above work surface (Class 10,000/ISO 7). Other permissible counts accord with nominal cleanliness rating (1000 per cf. for Class 1000, 100 per cf. for Class 100).
   b. Viable Count: Less than 1.5 colony forming units per 10 cubic feet. Other permissible counts in accord with nominal cleanliness rating.

3. Capable of maintaining a passive pressure differential of:
   a. Area outside room: balance condition
   b. Air lock: 0.05-inch w.g.
   c. Cleanroom: 0.1 inch w.g.

B. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.
1.4 SUBMITTALS
   A. Submit under provisions of Section 01 33 00 – Submittal Procedures.
   B. Product Data: Manufacturer’s data sheets on each product to be used, including:
      1. Preparation instructions and recommendations.
      2. Storage and handling requirements and recommendations.
      3. Installation methods.
   C. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and finish.
   D. Manufacturer’s Certificates: Certify products meet or exceed specified requirements.
   E. Closeout Submittals: Provide manufacturer’s maintenance instructions that include recommendations for periodic checking and adjustment of cable tension and periodic cleaning and maintenance of all railing and infill components.

1.5 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in the manufacture of products specified in this section with minimum 10 years documented experience.
   B. Installer Qualifications: Company specializing in performing work of this section with minimum 5 years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Store products in manufacturer’s unopened packaging until ready for installation.
   B. Do not deliver materials or assemblies to site until installation spaces are ready to receive units.

1.7 SEQUENCING
   A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
   B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 PRODUCTS

2.1 MANUFACTURERS
   A. Basis of Design: Terra Universal, Inc., which is located at: 800 S. Raymond Ave.; Fullerton, CA 92381-5234; Tel: 714-578-6017; Fax: 714-578-6020; Email:request info (info@TerraUniversal.com); Web: www.TerraUniversal.com
   B. Substitutions: Equal products will be permitted.
   C. Requests for substitutions will be considered in accordance with provisions of Section 01 25 13 - Product Substitution Procedures.

2.2 CLEAN ROOM PASS-THROUGH CHAMBERS
A. Metal Pass-Through Chambers
   1. Electropolished 304 Stainless Steel with Stainless Steel Doors/Dissipative PVC Windows.
      a. Wall Mount:
         1) Cat. # 1992-01D Outside Dimensions: 12 inches by 12 inches by 12 inches (610 mm by 610 mm by 406 mm)

2.3 PASS THROUGH CHAMBER ACCESSORIES AND OPTIONS

A. For each pass through:
   1. Include all necessary door mounting hardware.
   2. Mounting Brackets: Include stainless steel mounting brackets. All brackets require .25 inch (6 mm) clearance between the wall cut-out and the pass-through. Standard mounting is 2 inches (51 mm) from the front of the cleanroom side (specify other desired location).

B. Door Interlocks: FirmLock stainless steel Interlocks for Pass-Through Chambers. Mechanical interlock requires that both doors close on the same sidewall.
   1. Wall
      a. Cat. # 6705-50A Chamber Dimensions: 12 inches by 12 inches by 12 inches (verify compatibility)

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until openings and substrates have been properly prepared.
B. Verify exact location of clean room pass-throughs for installation.
C. Verify that rough openings and surfaces are ready to receive work.
D. If opening and substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
C. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install pass-throughs, plumb and level. Seal the perimeter of both sides of the openings.
C. Upon completion of installation operate unit and make necessary adjustments.
D. Connect mechanical and electrical services as required for complete and operable installation.
E. Mount sill/shelf of pass-through cabinet at 40 inches a.f.f.
3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 13 20 44
SECTION 14 21 23.16 - MACHINE-ROOM-LESS ELECTRIC TRACTION PASSENGER ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes machine-room-less electric traction passenger elevators.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.
2. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
3. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
4. Section 051200 "Structural Steel Framing" for the following:
   a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
   b. Hoist beams.
   c. Structural-steel shapes for subsills.
5. Section 055000 "Metal Fabrications" for the following:
   a. Attachment plates and angle brackets for supporting guide-rail brackets.
   b. Hoist beams.
   c. Structural-steel shapes for subsills.
   d. Pit ladders.
   e. Cants made from steel sheet in hoistways.
6. Section 260500 “Electrical General Provisions”
7. Section 280300 “Fire Alarm System”
8. Section 310000 “Earthwork”

1.3 DEFINITIONS

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

B. Service Elevator: A passenger elevator that is also used to carry freight.
1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include capacities, sizes, performances, operations, safety features, finishes, and similar information.
   2. Include Product Data for car enclosures, hoistway entrances, and operation, control, and signal systems.

B. Shop Drawings:
   1. Include plans, elevations, sections, and large-scale details indicating service at each landing, coordination with building structure, relationships with other construction, and locations of equipment.
   2. Include large-scale layout of car-control station and standby power operation control panel.
   3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples for Initial Selection: For each type of exposed finish involving color selection.

D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 3-inch- (75-mm-) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway and pit layout and dimensions, as indicated on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner with terms, conditions, and obligations as set forth in, and in same form as, a "Draft of Elevator Maintenance Agreement" at end of this Section, starting on date initial maintenance service is concluded.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.9 COORDINATION

A. Coordinate installation of inserts, sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, inserts, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Coordinate locations and dimensions of work specified in other Sections that relates to electric traction elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways and pits.

1.10 WARRANTY

A. Manufacturer’s Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

2. Warranty Period: 1 year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. KONE Inc.
2. Otis Elevator Co.
3. ThyssenKrupp Elevator
4. Major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with requirements for accessible elevators in the United States Access Board’s ADA-ABA Accessibility Guidelines and with ICC A117.1.
1. Project Seismic Design Category: C.
2. Elevator Component Importance Factor: 1.0.
3. Design earthquake spectral response acceleration short period (Sds) for Project is 0.000.
4. Provide earthquake equipment required by ASME A17.1/CSA B44.

2.3 ELEVATORS

A. Elevator System, General: Manufacturer’s standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.

B. Elevator Description:
1. Elevator Number(s): 1.
2. Rated Load: 4500 lb (2043 kg).
3. Freight Loading Class for Service Elevator(s): Class A.
4. Rated Speed: 150 fpm (0.75 m/s).
6. Auxiliary Operations:
   a. Standby power operation.
   b. Standby-powered lowering.
   c. Battery-powered automatic evacuation.
   d. Automatic dispatching of loaded car.
   e. Nuisance-call cancel.
   f. Loaded-car bypass.
   g. Off-peak operation.
   h. Automatic operation of lights and ventilation fans.
7. Car Enclosures:
   a. Inside Width: Not less than 66 3/16” from side wall to side wall.
   b. Inside Depth: Not less than 97 3/8” from back wall to front wall (return panels).
   c. Inside Height: Not less than 96” to underside of ceiling.
   d. Front Walls (Return Panels): Satin stainless steel, No. 4 finish.
   e. Car Fixtures: Satin stainless steel, No. 4 finish.
   f. Side and Rear Wall Panels: Satin stainless steel, No. 4 finish.
   g. Door Faces (Interior): Satin stainless steel, No. 4 finish.
   h. Door Sills: Aluminum.
   i. Ceiling: Satin stainless steel, No. 4 finish.
   j. Handrails: 3” flat bar satin stainless steel, No. 4 finish, at sides of car.
k. Floor prepared to receive resilient flooring (specified in Section 096516 "Resilient Sheet Flooring").

l. Floor Thickness, Including Setting Materials: See finish schedule for material above plywood subfloor.

8. Hoistway Entrances:
   a. Width: 48 inches (1219 mm).
   b. Height: 84 inches (2134 mm).
   c. Type: Two-speed side sliding.
   d. Frames: Satin stainless steel, No. 4 finish.
   e. Doors: Satin stainless steel, No. 4 finish.
   f. Sills: Aluminum.


10. Additional Requirements:
    a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
    b. Provide hooks for protective pads in all cars and one complete set(s) of full-height protective pads.

2.4 TRACTION SYSTEMS

A. Elevator Machines: Permanent magnet, variable-voltage, variable-frequency, ac-type hoisting machines and solid-state power converters.
   1. Provide nonregenerative system.
   2. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.

B. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.

C. Machine Beams: Provide steel framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 055000 "Metal Fabrications" for materials and fabrication.

D. Car Frame and Platform: Bolted- or welded-steel units.

E. Guides: Provide guides at top and bottom of car and counterweight frames.

2.5 OPERATION SYSTEMS

A. General: Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.

B. Auxiliary Operations:
1. Single-Car Battery-Powered Automatic Evacuation: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it moves to the next floor above or below, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.


C. Security features shall not affect emergency firefighters' service.

1. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at hall push-button stations. Key is removable only in deactivated position.

2. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes car to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

2.6 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.

2.7 CAR ENCLOSURES

A. General: Provide steel-framed car enclosures with nonremovable wall panels, with car roof, access doors, power door operators, and ventilation.

1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

B. Materials and Finishes: Manufacturer's standards, but not less than the following:

1. Subfloor: Exterior, underlayment grade plywood, not less than 5/8-inch (15.9-mm) nominal thickness.
2. Floor Finish: See Finish Schedule.
4. Fabricate car with recesses and cutouts for signal equipment.
5. Fabricate car door frame integrally with front wall of car.
7. Sight Guards: Provide sight guards on car doors.
8. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.
9. Stainless Steel Ceiling with Satin Finish: Flush panels, with LED lighting each panel.
2.8 HOISTWAY ENTRANCES

A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.
   1. Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.

B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252 or UL 10B.
   1. Fire-Protection Rating: 1-1/2 hours Insert rating.

C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
   2. Stainless-Steel Doors and Transoms: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
   4. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.
   5. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

2.9 SIGNAL EQUIPMENT

A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide vandal-resistant buttons and lighted elements illuminated with LEDs.

B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.
   1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
   2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.

E. Hall Push-Button Stations: Provide one hall push-button station at each landing.
   1. Provide manufacturer's standard wall-mounted units.
   2. Equip units with buttons for calling elevator and for indicating desired direction of travel.
a. Provide for connecting units to building security access system so a card reader can be used to register calls.

3. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Section 283111 "Digital, Addressable Fire-Alarm System."

F. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide one of the following:

1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
2. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
3. Units mounted in both jambs of entrance frame.
4. Units mounted in both car door jambs.

G. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

1. At manufacturer's option, audible signals may be placed on cars.

H. Hall Position Indicators: Provide illuminated, position indicators, located above hoistway entrance at ground floor. Provide units with flat faceplate and with body of unit recessed in wall.

1. Integrate ground-floor hall lanterns with hall position indicators.

I. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed.

J. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.

K. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.10 FINISH MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.

C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

D. Stainless-Steel Bars: ASTM A 276, Type 304.

E. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
F. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoistways, hoistway openings, and pits as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions.

B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.

E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

F. Leveling Tolerance: 1/8 inch (3 mm), up or down, regardless of load and travel direction.

G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

H. Locate hall signal equipment for elevators as follows unless otherwise indicated:

1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
2. Place hall lanterns either above or beside each hoistway entrance.
3. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.
3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Operating Test: Load elevator to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.

C. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

A. Temporary Use: Comply with the following requirements for elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate elevator(s).

B. Check operation of elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
1. Perform maintenance during normal working hours.
2. Perform emergency callback service during normal working hours with response time of two hours or less.

END OF SECTION 14 21 23.16
SECTION 21 10 00 - FIRE PROTECTION

PART 1 - GENERAL

1.1 PROJECT SUMMARY

A. Work in this Section includes, but is not necessarily limited to providing all engineering and associated costs, calculations, labor, materials, supervision, testing, permits and approvals required to design, install and obtain final acceptance of the automatic fire protection sprinkler system complete in all respects.

B. The fire protection system shall provide full and complete coverage of all areas, and shall be compatible with the contract document layouts and avoid interference with work of all other trades in the building. Contractor shall provide offsets as needed to avoid other trades, including but not limited to mechanical ductwork, hydronic piping, structural elements and lighting.

C. Provide fire protection system complete with all component equipment and material items. Install and test in full conformity with the requirements of all applicable codes, National Fire Protection Association (NFPA) 13-2006 Edition.

1.2 DEFINITIONS

A. Working Plans: Documents, including shop drawings, calculations, and material specifications prepared according to NFPA 13 for obtaining approval from authorities having jurisdiction.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Sprinkler system shall not be calculated to less than 5 psi or 10% below the actual water supply available, whichever is greater. Sprinkler plans and calculations must take into account and show elevation loss from the flow test location to the flowing sprinklers. Flow test information must be recent to within one (1) year previous to submittal of sprinkler drawings.

B. NFPA standards require that the spray deflector of the sprinkler heads be installed eighteen (18") inches minimum above the top of the shelves.

C. Sprinkler deflectors shall be positioned to avoid obstruction to both activation and discharge. Obstructions are (but are not limited to) lights, diffusers, duct-work, structural members (false or real), displayed signage or any object capable of impeding the proper activation and discharge of the fire sprinklers. Installation shall comply to the referenced NFPA 13 document (Chapter 4) and the manufacturers listing. The sprinkler contractor shall be responsible for final coordination.

D. All obstructions exceeding four (4') feet wide or which cannot be spaced around (to comply with 1.4.F) shall have sprinklers installed beneath the obstruction. If sprinklers are installed at or below 7'6" they shall be equipped with a listed head guard.
E. All sprinkler heads in finished ceilings shall be symmetrically spaced to provide proper coverage, and to avoid interference with lights, diffusers, grilles, or other ceiling mounted equipment. The head layout shall conform to the typical pattern and centered in any ceiling tile or similar feature.

F. All overhead piping located in areas containing ceilings shall run concealed above the ceiling, without exception.

G. Consult the bid specification drawings for acceptable locations for all piping to be run exposed (areas without ceilings).

H. Inspector's tests to be provided with half-inch orifice, discharging at three (3") inches above a hard paved surface. Provide pressure relief valves at inspectors test locations on all "grid" type systems. All inspector's test shall not be located behind racking or other obstructions, and shall be located within eighteen (18") inches of an exterior door opening.

I. Provide flushing and drainage as per required in NFPA 13.

J. Provide fire department connection. The exact placement and model of the fire department connection shall be verified with the local jurisdiction. Refer to the provided fire sprinkler drawings for location and arrangement.

K. System control valves accessed from the interior of the riser area and shall be tampered butterfly valves.

L. Provide sprinkler protection at electrical rooms per the requirements of the local jurisdiction.

M. The calculations shall include all sprinklers within the most hydraulically demanding area along each branch line within the distance determined using a 1.2 multiplier (times the square feet of the area).

N. The contractor shall provide a valve connection discharging onto a paved (outside) surface, to allow full system demand to flow forward of the backflow preventor for testing. The test connection shall be capable of full system flow and shall not require system drainage or alteration. Note, the two (2") inch main drain and FDC are not acceptable.

PART 2 - PRODUCTS

2.1 GENERAL PARAMETERS

A. All materials submitted and installed shall be UL listed, individually or as any assembly to be installed in a fire protection system.

B. All materials shall be acceptable to all national and local applicable codes and standards.

2.2 SPRINKLER HEADS

A. No sprinklers to be installed are permitted to have a rubber O-ring seal. Only metallic "spring seal" or equivalent seals are allowed.

B. All sprinkler types and temperature ratings shall be as indicated on the drawings.
2.3 BRACKETS

A. Brackets for attaching pipe hangers to building structure shall be the size and type for the intended use, and acceptable to the structural engineer in accordance with NFPA 13.

2.4 SWITCHES

A. Provide all tamper and flow switches for indicating control valves and systems and as required by local ordinances.

2.5 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Specialty Valves and Devices:
   a. Grinnell Corp.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Viking Corp.

2. Water-Flow Indicators and Supervisory Switches:
   a. Grinnell Corp.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Viking Corp.

3. Sprinkler, Drain and Alarm Test Fittings:
   a. Central Sprinkler Corp.
   b. Grinnell Corp.
   c. Victaulic Co. of America

4. Sprinkler, Branch-line Test Fittings:
   b. Fire-End and Croker Corp.

5. Sprinkler, Inspector's Test Fittings:
   a. Fire-End and Croker Corp.
   b. G/J Innovations, Inc.
   c. Triple R. Specialty of Ajax, Inc.
6. Fire Department Connections:
   a. Grinnell Corp.
   b. Guardian Fire Equipment, Inc.
   c. Reliable Automatic Sprinkler Co., Inc.

7. Sprinklers:
   a. Grinnell Corp.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Viking Corp.

8. Indicator Posts and Indicator-Post, Gate Valves:
   b. Grinnell Corp.
   c. Nibco, Inc.

9. Indicator Valves:
   a. Grinnell Corp.
   b. Nibco, Inc.
   c. Victaulic Co. of America

10. Fire Protection-Service Valves:
    a. Grinnell Corp.
    b. Nibco, Inc.
    c. Victaulic Co., of America

11. Grooved Couplings for Steel Pipe
    a. Grinnell Corp.
    b. National Fittings, Inc.
    c. Victaulic Co. of America

2.6 PIPE AND FITTINGS

A. Ductile-Iron Pipe: AWWA C151, push-on-joint type, with cement-mortar lining and seal coat according to AWWA C104. Include rubber gasket according to AWWA C111.

B. Ductile-Iron Pipe: AWWA C151, mechanical-joint type; with cement-mortar lining and seal coat according to AWWA C104. Include glad, rubber according to NFPA 1963 and matching local fire department sizes and threads, and bottom outlet with pipe threads. Include brass, lugged caps, gaskets, and brass chains; brass, lugged swivel connection and drop clapper for each hose-connection inlet; eighteen (18") inch (460-mm) high brass sleeve; and round, floor, brass, escutcheon plate with marking "AUTO SPKR."

2. Finish Including Sleeve: Rough chrome-plated.

C. Other Pipe: ASTM A795, Sch 40 Steel Pipe (or Sch 10 where allowed by NFPA 13).

2.7 FIRE DEPARTMENT CONNECTIONS

A. Water-Flow Indicators: UL 346; electrical-supervision, vane-type water-flow detector; with 250 psig (1725-kPa) pressure rating; and designed for horizontal or vertical installation. Include two (2) single-pole, double-throw, circuit switches for isolated alarm and auxiliary contacts 7A, 125-V ac and 0.25A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that send signal if removed.

B. Pressure Switches: UL 753; electrical-supervision type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.

C. Valve Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

D. Indicator-Post Supervisory Switches: UL 753; electrical; single-pole, double throw, with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.

2.8 PRESSURE GAUGES

A. Pressure Gauges: UL 393, 3 ½ to 4 ½ inch - (90 to 115 mm) diameter dial with dial range of 0 to 300 psig (0 to 1725 kPa).

PART 3 EXECUTION

3.1 INSTALLATION

A. Furnish and install under this Section all hangers and steel fabrications, other than building structure, required for proper support of piping and equipment.

3.2 IDENTIFICATION

A. Identify exposed or accessible piping with snap-on or strap-on type markers. Color or markers shall be red for all fire protection service. Indicate pipe contents and direction of flow on marker. Install markers on piping not more than 20 feet apart, at valves, at access panels and at least once above each space.

3.3 HANGER ATTACHMENTS

A. Support of pipes with diameter larger than 2 inches may require modification of structural members to support increased loads. Suspend piping and equipment supported by building structure only by those methods, and only at those locations acceptable to the structural engineer.
B. Provide supplementary supporting steel fabrication to bridge between structural steel fabrication to bridge between structural members to receive the hanger. Attach supplementary members to building structure only by those methods, and at those locations acceptable to the structural engineer.

3.4 INSPECTION, TESTING, AND CLEANING

A. Arrange for all inspections, examinations and tests in full conformity with the requirements of all applicable codes, National Fire Protection Association (NFPA) standards and authority having jurisdiction necessary to obtain complete and final acceptance of the fire sprinkler system.

B. Flush underground piping and pressure test at 200 psi for two (2) hours prior to connection to overhead piping. Flushing and testing shall be witnessed by the Fire Department.

C. Leave entire sprinkler system clean in every respect at the conclusion of the work.

D. Testing will occur after installation of all systems has been completed (approximately two (2) to three (3) weeks prior to opening). The contractor shall be required to provide a lift, air, and water pumps for system pressurization, and any necessary hand tools and apparatus for complete testing and draining of the systems. One (1) test of all systems should be completed within one (1) day. If all or any systems fail, the contractor shall be responsible to be present and furnish all items listed above until such time that systems are found to be acceptable or in accordance with NFPA 13, 25, and the bid documents. The contractor is responsible for notifying the Owner when installation is complete and testing may begin. Please allow five (5) to ten (10) working days for scheduling.

E. The contractor shall furnish to the owner a complete set of signed and witnessed test certificates for the following:

1. Underground flushing.
2. Underground hydrostatic test.
3. Interior wet system hydrostatic test(s).
4. All system trip tests.

F. The Contractor shall train owner on use of all equipment and furnish two (2) copies to be left on site, of NFPA 25 the latest edition, and all apparatus manuals, please allow seven (7) days for scheduling.

3.5 WARRANTY

A. Provide warranty in accordance with the General Conditions for a period of at least one (1) year.

END OF SECTION 21 10 00
SECTION 22 05 00 - GENERAL PROVISION FOR PLUMBING

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Conform to the following:

1. International Plumbing Code - 2012

1.2 STANDARDS

A. Comply with all pertinent standards.

1. AWS: American Welding Society.
2. ASME: American Society for Mechanical Engineers.
3. MSS: Manufacturer's Standard Society.

1.3 SUBMITTALS

A. Submit under provisions of Division 01.

1. Submit complete descriptions, specification data for material and equipment proposed. Clearly indicate proposed items when other items are shown on same sheet.
2. Submittals in 3-ring binders shall include an index of contents and divider tabs.
3. Shop Drawings:
   a. Plumbing Fixtures and Hardware
   b. Piping Systems
   c. Valves
   d. Insulation
   e. Pumps
   f. Water Heaters
   g. Plumbing Specialties
   h. Seismic Certification: Submit letter of certification from each equipment manufacturer verifying that equipment is designed to withstand horizontal forces as defined on structural drawings.

1.4 REGULATORY REQUIREMENTS

A. Perform Work specified in Division 22 in accordance with 2012 IPC and by the authority having jurisdiction.
1.5 PROJECT/SITE CONDITIONS

A. Layouts indicated on drawings are diagrammatical and intended to show relative positions and arrangement of equipment and piping. Coordinate plumbing work with other trades and measurements obtained at the job site, as applicable, prior to installation. Generally, install work in locations shown on Drawings, using as necessary, rises, drops, offsets, and alternate routings to fit in the available space unless prevented by Project conditions.

1.6 COMPLETENESS OF WORK

A. The Contract Documents depict plumbing systems which are intended to be complete and functioning systems. All products, materials, and labor necessary to render a fully functional system to fulfill the design intent shown on the documents shall be provided by the Contractor.

B. Model numbers referenced throughout the Division 22 Drawings and Specifications are intended to convey a general understanding of the type and quality of the product required. Where written descriptions differ from information conveyed by a model number, the written description shall govern. No extra shall be allowed because a model number is found to be incomplete or obsolete.

1.7 RECORD DRAWINGS

A. Provide record drawings that illustrate the work of Division 22 as finally constructed. Provide dimensions of material installed below slab/grade from fixed and visible reference points. Deliver record drawings to the architect in a form suitable for production.

B. Record drawings shall reflect all changes made to the Contract Documents, whether generated by addenda, change orders, or field conditions. Maintain a daily record of these changes and keep current set of drawings showing these changes.

C. Deliver record drawings to Architect within 30 days of Substantial Completion.

1.8 OWNER AND OPERATING MANUALS

A. Comply with the requirements of Division 1, but provide a minimum of three sets, in three ring binders, all sets identical.

B. Manuals shall include clear and comprehensive operating instructions with appropriate graphics and project specific marked data to enable owner to operate and maintain all systems specified in this Division.

C. Copies of approved submittals on furnished equipment shall be included.

1.9 EXISTING SERVICES

A. Maintain existing services in operation during construction. Coordinate and schedule all service interruptions with Owner.
PART 2 - PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 EXCAVATING AND BACKFILLING
   A. Provide trenching, excavating, and backfilling necessary for performance of plumbing work in accordance with Division 02.

3.2 CUTTING AND PATCHING
   A. Repair or replace damage caused by cutting or installation of work specified in Division 22.
   B. Perform repairs with materials which match existing and install in accordance with the appropriate section of these specifications.
   C. Correct unnecessary damage caused due to the installation of plumbing work.

3.3 FLASHING AND COUNTERFLASHING
   A. Counterflash pipes where penetration of roofs and outside walls occur.

3.4 DELIVERY, STORAGE, AND PROTECTION
   A. Insofar as possible, deliver items in manufacturer's original unopened packaging. Where deliver in original packaging is not practical, provide cover and shielding for all items with protective materials to keep them from being damaged. Use care in loading, transporting, unloading, and storing to keep items from being damaged.
   B. Store items in a clean, dry place, and protect from damage. Mechanical equipment may not be staged or stored outdoors unless intended for outdoor use. Do not install damaged or wet insulation; Remove from site.
   C. Protect nameplates on motors, pumps, and similar equipment. Do not paint or insulate over nameplate data.
   D. Protect valves and piping from damage. Cover equipment during work of finishing trades.
   E. Keep dirt and debris out of pipes.
   F. Repair, restore, and replace damaged items.
   G. Cover factory finished equipment during work of finished trades, such plumbing fixtures and water heaters.
3.6 SLEEVES
   A. Floors: Sleeve all pipe penetrations. Extend sleeve 1-1/2" above finished floor, except piping within pipe chases. Sleeve shall be flush with underside of floor.
   B. Masonry or concrete walls: Sleeve all pipe penetrations. Sleeves shall be flush on both sides of wall.
   C. Drywall partitions: Sleeve all penetration of piping in systems over 160 degree F.
   D. Seal voids between outside surface of sleeve and wall, partition or floor. Seals shall be airtight.
   E. Install piping, insulation and sleeves in strict accordance with applicable U.L. floor or partition assembly instructions. Coordinate with Division 07 firestop manufacturer's installation instructions.
   F. Penetrations not sleeved or firestopped:
      1. Seal voids between pipe and partition. Seals shall be airtight.

3.7 ESCUTCHEON PLATES
   A. Provide chromium plates escutcheon plates for exposed uninsulated pipes projecting through floors or walls in "finished" spaces. Mechanical rooms, store rooms, electric closets, and janitor closets are not considered "finished" spaces.
   B. Clearance between sleeve and pipe: Minimum of 1/2 inch for hot piping and 1 inch for cold piping or as otherwise dictated by U.L. Fire Resistance Directory.

3.8 TESTING
   A. Test all installed equipment and systems and demonstrate proper operation. Correct and retest work found defective when tested.
   B. Thoroughly check piping system for leaks. Do not add any leak-stop compounds to the system. Make repairs to piping system with new materials. Peening, doping, or caulking of joints or holes is not acceptable.
   C. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at a water pressure of 125 psig for two hours without leaks.
   D. Test drainage and venting system with necessary openings plugged to permit system to be filled with water and subjected to a minimum water pressure of 10 feet head at top of system. System to hold water for two hours without a water level drop greater than 4" in a 4" standpipe and without visible leakage. Test system in sections if minimum head can be maintained in each section.
   E. Conduct air or smoke test if in opinion of Designer reasonable cause exists to suspect leakage or low quality workmanship.
F. Test foundation drain system in sections of 100 foot lengths before and after backfilling. Pass plumbers tape or Roto-Rooter through drain sections to ensure there are no restriction to water flow.

G. Test flush valves for proper operation.

END OF SECTION 22 05 00
SECTION 22 05 53 - IDENTIFICATION OF PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL (NOT USED)

PART 2 - PRODUCTS

2.1 NAMEPLATES AND TAGS
   A. Acceptable manufacturers: Seton Nameplate or Brady.
   B. Rigid plastic, "Setonite" or bakelite with engraved lettering, minimum 1/2" high.
   C. Brass tags, at least 1-1/2" inches in diameter, with alpha-numeric I.D., permanently stamped black filled letters showing the service, and black filled numbers showing the equipment number. At substantial completion, a schedule of all valves shall be submitted to the Architect and Owner's Representative.

2.2 PIPE MARKERS
   A. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering.

2.3 PIPE IDENTIFICATION
   A. Pipe Identification:
      1. Identify piping by snap-on or strap-on labels (to denote contents and direction of flow) on piping at no more than 20 foot intervals at valves, and at least once in each separate space through which the pipe passes.
      2. All piping in mechanical rooms shall be labeled to identify contents and direction of flow.

2.4 EQUIPMENT AND APPARATUS IDENTIFICATION
   A. Acceptable Manufacturers: Seton Name Plate Corporation or equal.
   B. Nameplates: Rigid plastic, "Setonite", Seton or Brady with engraved lettering (indicating names and numbers of mechanical apparatus), a minimum of 1/2" high. Fill engraved lettering with a permanent coloring material which contrasts with color of tag material to allow for easy reading.
   C. Use names, numbers, and abbreviations appearing in schedules on Contract Drawings.
   D. Provide nameplates, located in a conspicuous location directly on the equipment or apparatus, for mechanical equipment including, but not limited to:
      1. Water heater
      2. Pump
3. Control panel
4. Plumbing equipment

E. Name tag Fasteners: Commercial quality, rust resisting nuts and bolts with backwashers, self-tapping screws, or rivets. If equipment surface does not allow for direct attachment, use copper or brass rings to attach tags.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install pipe identification markers per manufacturer's installation instructions.

B. Install equipment nameplates per manufacturer's installation instructions.

END OF SECTION 23 05 53
SECTION 22 07 19 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 QUALITY ASSURANCE:

A. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 method.

1.2 EXISTING SERVICES

A. Maintain existing services in operation during construction. Coordinate and schedule all service interruptions with Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

Johns Manville Corp.
Owens-Corning Fiberglas Corp.
Rubatex Corp.

2.2 PIPING INSULATION MATERIALS:

A. Fiberglass Piping Insulation: ASTM C 547, Type 1 unless otherwise indicated.

B. Flexible Unicellular Piping Insulation: ASTM C 534, Type I (Tubular).

C. Encase the following with PVC jacket equal to John Manville Zeston 2000 Series with color selected by Architect:

1. All exposed interior piping insulation within 7'-0" of floors or work surfaces.
2. All valves and fittings.

D. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

E. Tees and elbows for insulated piping shall be factory premolded insulation fittings, similar to that manufactured by Hamfab.

F. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.
2.3 EQUIPMENT INSULATION MATERIALS:

A. Flexible Unicellular Equipment Insulation: ASTM C 534, Type II.

B. Jacketing Material for Equipment Insulation: Provide metal jacket, except as otherwise indicated.

C. Equipment Insulation Compounds: Provide adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

D. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors and stud pins as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PLUMBING PIPING SYSTEM INSULATION:

A. Insulation Omitted: Omit insulation on chrome-plated exposed piping (except for handicapped fixtures), air chambers, unions, strainers, check valves, balance cocks, flow regulators, drain lines from water coolers, and pre-insulated equipment.

B. Cold Piping:

1. Application Requirements: Insulate all cold plumbing piping systems, which include the following:
   a. Potable cold water piping.
   b. Horizontal interior above-ground storm water piping.
   c. Condensate piping.

2. Insulate each piping system specified above with one of the following types and thicknesses of insulation with a thermal conductivity of 0.24 to 0.28 BTU · in/(h · ft · °F):
   a. Fiberglass: 1/2" thickness for cold water.
   b. Fiberglass: 1" thickness for storm water.
   c. Fiberglass: 1/2" thickness for condensate piping.

C. Hot Piping:

1. Application Requirements: Insulate all hot plumbing piping systems, which include the following:
   a. Potable hot water piping.
   b. Potable hot water recirculating piping.

2. Insulate each piping system specified above with one of the following types and thicknesses of insulation with a thermal conductivity of 0.24 to 0.28 BTU · in/(h · ft · °F):
   a. Fiberglass: 1" thick for potable hot water supply.
b. Fiberglass: 1” thick for recirculating hot water piping.

D. Glass fiber blanket inserts with PVC covers are not acceptable for pipe fitting insulation.

E. Hangers:
   1. All hanger nuts to be tighten AFTER insulation is added to the piping.
   2. All metal shields should be installed BEFORE nuts are tightened. Minimum shield length shall be 12”.
      Provide a section of Foamglass insulation between pipe and metal shield to prevent crushing of insulation. All shields shall be 14 gauge.

F. Protection
   1. All damaged insulation caused by maintenance or construction shall be replaced by contractor, up to and through the completion of the Punch List.

3.3 INSTALLATION OF PIPING INSULATION:

A. Use glass fiber sectional pipe insulation for domestic water piping. Glass fiber factory premolded fitting matching basic insulation equivalent to that manufactured by Hamfab shall be provided at all pipe fittings (Tees and ells) and finished with glass fabric and vapor barrier mastic. Glass fiber blanket inserts with PVC covers are not acceptable for pipe fitting insulation.

B. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

C. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

D. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

E. Clean and dry pipe surfaces prior to insulating. All butt-joints for cold water or condensate drain lines must be glued securely any openings to prevent the build-up of condensation.

F. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage. Repair any insulation jacket damaged so it has permanent seal. Cover all joints, rips, tears punctures, staples, insulpins or breaks in vapor barrier jacket with 4” wide woven glass fabric embedded in vapor barrier fire resistant mastic.

G. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run.

H. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

I. For hot pipes, apply 3” wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3” wide vapor barrier tape or band. Piping insulation to continue through 100% of pipe hangers. No insulation shall be cut where a hanger is located for any loop water, cold water or condensate drain lines.
J. Insulate all domestic water valves that could condensate and drip.

K. For any service when above grade, exposed to weather outside building, and exposed in equipment rooms to within 7 feet above floors, cover pipe insulation with 0.016” thick smooth aluminum jacket equivalent to Childers and cover valves and fittings with .024” thick aluminum factory formed covers equivalent to Childers E11-Jacs.

3.4 INSTALLATION OF EQUIPMENT INSULATION:

A. General: Install equipment thermal insulation products in accordance with manufacturer’s written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

D. Apply insulation using staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

E. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

F. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2”. Apply over vapor barrier where applicable.

G. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

H. Hangers:
   1. All hanger nuts to be tighten AFTER insulation is added to the equipment
   2. All metal shields to be installed BEFORE nuts are tightened.

I. Protection
   1. If equipment will be walked on to do further maintenance or construction work then the insulation will be replaced by contractor, up to and through the completion of the punch list.
   2. If equipment that is insulated may need to be walked on for the long-term maintenance of the building, proper shields will be provided at traffic ways that cross the piping.

3.5 PROTECTION AND REPLACEMENT:
A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

3.6 PVC JACKET

A. Encase all exposed interior piping within PVC jacket per manufacturer’s installation instructions.

END OF SECTION 22 07 19
SECTION 22 08 00 – PLUMBING SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification Section 01 91 13 – Commissioning

C. Specification Section 23 08 00 – Mechanical & Controls Systems Commissioning

D. Specification Section 26 08 00 – Electrical & Lighting Systems Commissioning

G. Commissioning Plan (to be provided in Construction Phase containing process workflows, communication protocols, project-specific equipment checklists and project-specific functional performance test procedures)

1.2 COMMISSIONED SYSTEMS

A. The following systems, equipment and their components are included in the scope of the commissioning activities and are considered to be commissioned systems and equipment.

1. Plumbing Piping and Valves

2. Plumbing Piping Specialties

3. Domestic Water Pumps

4. Water Heaters – Electric

1.3 RESPONSIBILITIES

A. The Contractor shall be responsible for scheduling, supervising and performing start-up, testing and commissioning activities specified in this section and necessary to demonstrate to the Owner successful operation of the commissioned systems.

PART 2 - PRODUCTS

2.1 MEANS OF ACCESS

A. The Contractor shall provide means for the CxA to access, observe and visually confirm proper operation of all equipment and systems. These means shall be in compliance with all OSHA and job-site safety regulations.
2.2 TEST EQUIPMENT

A. The Contractor shall provide the necessary equipment to fully test the commissioned systems as defined in the functional performance test procedures to be provided by the CxA.

B. The test equipment shall meet the following minimum requirements.
   1. All test equipment shall be in good mechanical and electrical condition.
   2. Accuracy of metering in test equipment shall be appropriate for the test being performed.

C. Calibration
   1. Calibration of all test equipment shall be current.
   2. Calibration accuracy shall be traceable to National Institute of Standards and Technology (NIST).
   3. Test equipment shall be calibrated in accordance with the following schedule.
      a. Field instruments
         1) Analog – At least every 6 months
         2) Digital – At least every 12 months
      b. Leased Specialty Equipment – At least every 12 months
   4. Dated calibration labels shall be visible on all test equipment.
   5. Calibration records shall be provided for all test equipment used in the project.

PART 3 EXECUTION

3.1 EQUIPMENT RECEIPT INSPECTION CHECKLISTS

A. Equipment receipt inspection checklists, provided by the CxA, shall be completed by the Contractor online using CxAlloy TQ commissioning software. Free access to the software will be provided by the CxA to the Contractor's personnel.

3.2 EQUIPMENT PRE-FUNCTIONAL CHECKLISTS

A. Equipment pre-functional checklists, provided by the CxA, shall be completed by the Contractor online using CxAlloy TQ commissioning software. Free access to the software will be provided by the CxA to the Contractor's personnel.

3.3 START-UP PLAN

A. The Contractor shall perform start-up testing for each piece of equipment to ensure that the equipment and systems are properly installed and ready for operation, so that functional performance testing may proceed without delays.
B. The Contractor shall prepare a start-up plan for each piece of equipment. This plan shall be submitted to the CxA for review and comment. The start-up plan shall consist, at a minimum of the following:

1. The manufacturer’s standard start-up and check out procedures copied from the installation manuals.

2. Checklists and procedures with specific spaces for recording and documenting the inspection of each procedure and a summary block for deficiencies and explanations.

C. Two (2) weeks prior to expected start-up for a piece of equipment, the Contractor shall notify the Owner and the CxA in writing. The execution of the start-up plan shall be directed and performed by the Contractor. The CxA and/or the Owner may be present for the start-up of the first unit of each type of equipment.

D. The Contractor shall submit the completed equipment checklists to the CxA for review. The Contractor shall note all non-compliance items on these checklists. The Contractor shall notify the CxA when outstanding items have been corrected.

E. The Contractor shall complete the start-up plan and resolve or correct all issues resolved before functional testing may begin.

3.4 FUNCTIONAL PERFORMANCE TESTS

A. The Contractor shall provide all documentation as requested to the CxA for development of functional performance testing procedures. This documentation shall include, at a minimum, manufacturer installation, start-up, operation and maintenance procedures. The CxA may request further documentation as necessary for the development of functional performance tests.

B. Functional performance tests shall be performed on all of the commissioned systems and equipment.

C. The Contractor shall review the functional performance test procedures developed by the CxA.

1. The Contractor shall respond in writing to the CxA regarding the acceptability of the proposed test procedures.

2. The Contractor shall note any necessary modifications to the procedures due to the actual equipment/systems or safety concerns and shall submit these to the CxA for consideration.

E. The Contractor shall place equipment and systems into operation and continue the operation as required during each working day of the testing activities.

F. The Contractor shall accomplish the functional performance testing of equipment based on procedures developed by the CxA and as reviewed by the Contractor.

1. The Contractor shall provide skilled technicians to operate the systems during functional performance testing. At a minimum, the contractor should provide one trade technician familiar with the system being tested and one controls technician to operate the system through the BAS.

2. The Contractor shall correct any deficiencies identified during testing and retest equipment as required.

G. Functional performance testing is intended to begin upon completion of a system. Functional performance
H. Functional testing shall verify all sequences of operation defined in the Contract Documents for the commissioned equipment and systems.

1. Testing shall occur by overriding setpoints or sensor readings at the BACS or by other means mutually agreed to by the Contractor, the CxA, and the Owner to initiate sequences of operation and verifying the response of the system.

2. Sequences of operation shall be verified under normal power, emergency power, and fire alarm scenarios.

I. Upon successful completion of all functional performance tests, the Contractor(s) shall perform Integrated Systems Testing. The testing shall document and verify the proper response of all Division 23 systems to all potential utility and emergency power operating and failure scenarios.

END OF SECTION 22 08 00
SECTION 22 10 05 - PLUMBING PIPING & VALVES

PART 1 GENERAL

1.1 REFERENCES

A. Submit pipes, valves and fittings and have approval prior to starting construction. Pipe, valves and fittings shall be new and clearly marked with manufacturer’s name, classification and working pressure.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING, BURIED

A. PVC Pipe: ASTM D 2665 or ASTM D 3034.
   1. Fittings: PVC.

2.2 SANITARY SEWER AND CONDENSATE PIPING, ABOVE GRADE

A. Sanitary Sewer - Cast Iron Pipe: CISPI 301, hubless svc. wt.
   1. Fittings: DWV Cast Iron.

B. Condensate Piping - Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), Drawn (H).
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

2.3 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Pipe: ASTM B 42, hard drawn.
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.

2.4 WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), Drawn (H).
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2.5 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:
   1. Ferrous pipe: Class 150 malleable iron threaded unions.
   2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 1 Inch:
   1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
   2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.6 PIPE HANGERS AND SUPPORTS

A. Plumbing Piping - Drain, Waste, and Vent:
   2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Carbon steel, adjustable swivel, split ring.
   3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
   4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
   5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
   8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

B. Plumbing Piping - Water, Vacuum, Air
   2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Carbon steel, adjustable swivel, split ring.
   3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
   5. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.
   7. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

2.7 BALL VALVES

A. Construction, under 2 Inches: MSS SP-110, Class 150, 400 psi (2760 kPa) CWP, bronze, two piece body, stainless steel brass ball, full port, teflon seats and stuffing box ring, blow-out proof stem, lever handle, threaded ends with union. Nibco TS 585 or approved equal.
2.8 AIR VENTING
   A. Provide manually operated air vents at high points in vertical risers to eliminate air from systems.
   B. Use ball valves for manual air vents.

2.9 ESCUTCHEONS
   A. Provide chrome plated escutcheons where insulated pipes penetrate walls or ceilings of finished spaces.

PART 3 EXECUTION

3.1 EXAMINATION
   A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION
   A. Ream pipe and tube ends. Remove burrs.
   B. Remove scale and dirt, on inside and outside, before assembly.
   C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION
   A. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise. Install piping free of sags and bends. Group piping whenever practical at common elevations.
   B. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
   C. Do not use bullhead tees.
   D. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
   E. Install fittings for changes in direction and branch connections.
   F. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
   G. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
   H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

J. Provide access where valves and fittings are not exposed. Install piping to permit servicing.

K. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.

L. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

M. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

N. Install bell and spigot pipe with bell end upstream.

O. Install valves with stems upright or horizontal, not inverted.

P. Install water piping to ASME B31.9.

3.4 SLEEVES AND INSERT

A. Sleeve pipes passing through partitions, walls and floors.

B. Inserts:

1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

3.5 PIPE HANGERS AND SUPPORTS:

A. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
10. Provide hangers adjacent to motor driven equipment with vibration isolation.

3.6 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

3.7 ERECTION TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/8 inch per foot slope.

B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.8 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect water distribution system.

B. Prior to starting work, verify system is complete, flushed and clean.

C. Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.9 SCHEDULES

A. Pipe Hanger Spacing:

1. Metal Piping:

   a. Pipe size: 1/2 inches to 1-1/4 inches:
1) Maximum hanger spacing: 6.5 ft.
2) Hanger rod diameter: 3/8 inches.

b. Pipe size: 1-1/2 inches to 2 inches:
1) Maximum hanger spacing: 10 ft.
2) Hanger rod diameter: 3/8 inch.

c. Pipe size: 2-1/2 inches to 3 inches:
1) Maximum hanger spacing: 10 ft.
2) Hanger rod diameter: 1/2 inch.

d. Pipe size: 3 inches to 4 inches:
1) Maximum hanger spacing: 12 ft.
2) Hanger rod diameter: 1/2 inch.

END OF SECTION 22 10 05
SECTION 22 10 06 - PLUMBING PIPING SPECIALTIES

PART 1 GENERAL (NOT USED)

PART 2 PRODUCTS

2.1 BACKFLOW PREVENTERS

A. Reduced Pressure Backflow Preventers:

1. Provide Wilkins Series 975 (3/4" - 2") Series 375 (2-1/2" - 4") or Watts Series 909 (3/4" - 4").

Provide Wilkins 375-FS for 6" and greater service. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks. Design such that total pressure drop through complete backflow preventer does not exceed 12 psi at rated flow.

2.2 WATER HAMMER ARRESTORS

A. Water Hammer Arrestors:

1. Copper construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range 34 to 250 degrees F (1 to 120 degrees C) and maximum 150 psi (1000 kPa) working pressure.

2.3 MIXING VALVES

A. Thermostatic Mixing Valves:

1. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.

2. Accessories:
   a. Check valve on inlets.
   b. Volume control shut-off valve on outlet.
   c. Stem thermometer on outlet.
   d. Strainer stop checks on inlets.

3. Cabinet: 16 gage enameled steel, for surface mounting with keyed lock.

2.4 BALANCING VALVES

A. Memory-Stop Balancing Valves

2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 2 or smaller.
4. Body: Copper alloy.
5. Port: Standard or full port.
7. Seats and Seals: Replaceable.
8. End Connections: Solder joint or threaded.

2.5 WALL HYDRANTS

A. Nonfreeze Wall Hydrants

3. Operation: Loose key.
4. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
7. Box: Deep, flush mounted with cover.
8. Box and Cover Finish: Chrome plated.
11. Operating Key(s): One with each wall hydrant.

2.6 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device

4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.7 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves

2. Pressure Rating: 400-psig minimum CWP.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
8. Inlet: Threaded or solder joint.

2.8 CLEANOUTS

A. Cleanouts at Exterior Surfaced Areas
   1. Round cast nickel bronze access frame and non-skid cover.

B. Cleanouts at Exterior Unsurfaced Areas
   1. Line type with lacquered cast iron body and round epoxy coated gasketed cover.

C. Cleanouts at Interior Finished Floor Areas
   1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

D. Cleanouts at Interior Finished Wall Areas
   1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

E. Cleanouts at Interior Unfinished Accessible Areas Caulked or threaded type.
   1. Provide bolted stack cleanouts on vertical rainwater leaders.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install floor cleanouts at elevation to accommodate finished floor.

E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.

F. Pipe relief through fixed airgap and discharge to sewer.
G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water risers and supply piping to lavatories.

H. Install supply type, trap-seal primer valves with outlet piping pitches down toward drain trap at a minimum of 1 percent, and connect to floor drain body, trap or inlet fitting. Adjust valve for proper flow.

END OF SECTION 22 10 06
SECTION 22 10 10 - VACUUM PIPING SYSTEM

PART 1 GENERAL

1.1 WORK INCLUDED

A. Furnish and test the vacuum system.

B. Outlets, valve boxes, valves, alarm systems, pressure and vacuum switches, vacuum pump and miscellaneous accessories for complete systems.

C. Vacuum pump is specified on plumbing drawings.

D. Electrical power wiring for vacuum pump and other electrical accessories associated with the system shall be furnished and installed under Division 26.

E. Medical gas contractor shall furnish and install all low voltage control raceways and wiring associated with alarms and controls.

1.2 CODE COMPLIANCE/QUALITY ASSURANCE

A. Install in compliance with the recommendations of the National Fire Protection Association (NFPA) as set forth in locally enforced editions of NFPA 99 and NFPA 50.

B. Comply with all local, state or federal codes applicable in this jurisdiction.

C. Employ only qualified journeymen for this work. Employ a competent qualified mechanic/piping foreman, who has satisfactorily completed at least five other similar hospital installation, for this work. Provide brazers performance qualification test records for each brazer used on installation.

1.3 COORDINATION

A. Coordinate with other trades to assure timely installations and to avoid conflicts and interference.

B. Work closely with the metal stud partition installer and/or mason to assure that anchors, sleeves and similar items are provided in sufficient time to avoid delays; chases and openings are properly sized and prepared.

C. Coordinate layout of vacuum piping in all spaces.

PART 2 PRODUCTS

2.1 PIPING MATERIALS AND HANGERS

A. All vacuum piping shall be seamless Type K or L (ASTM B819) copper tubing, pre-cleaned for oxygen use, in accordance with NFPA 9. Piping shall be pre-cleaned, marked and plugged by supplier before shipment to job site. Any system operating above 200 psi shall have Type K tubing.
B. Fittings: Wrought copper brass or bronze designed expressly for brazed connection. All fittings shall comply with ANSI B16.22. Cast fittings shall not be used.

C. Brazing alloy: Melting point of at least 1000 degrees F.

D. Flux: Do not use for copper-to-copper joints. Use flux for joining copper to brass or bronze. In those cases where flux is used, exercise particular care in applying the flux to avoid leaving any excess inside the completed joints.

E. Pipe hangers shall be copper coated adjustable swivel ring, typical of B-Line B3170CT. Strut systems may be incorporated with rubber isolators, typical of B-Line Vibra Cushion or Vibra Clamp pipe clamps. The taping of pipes for isolation shall not be permitted. Medical gas piping within metal stud walls shall be supported with plastic isolators such as Pipe-Tytes System or equivalent.

2.2 MEDICAL VACUUM PUMP

A. The medical vacuum pump shall be a factory assembled and tested package, pre-wiring and pre-piped on a fabricated steel base, ready for single point connection at the job site. Specifically, there is one electrical connection, single manifold discharge connection, and one vacuum connection to hospital.

B. The vacuum pump shall have a rated SCFM capacity at 19" HG, horsepower and electrical requirements as scheduled on the drawings.

C. Furnish all required accessories for installing the vacuum pump (vibration dampeners, isolation pads or springs, flex connectors on incoming and exhaust lines, etc.)

D. The control cabinet shall be a U.L. listed NEMA 12 dustproof cabinet. The cabinet shall contain the following:
   1. Fusible disconnect or circuit breaker switches for pump.
   2. Magnetic motor starters with thermal overload protection for pump.
   3. Vacuum control switches set to maintain the vacuum level between a minimum of 19 inches H.G. and a maximum setting of 25 inches H.G.
   4. Thermal overload reset buttons.
   5. Local alarm for high discharge temperature and output signal for master alarm panel.

E. The warranty for the vacuum pump system shall be 18 months from start-up or 24 months from date of shipment, whichever comes first.

F. Motor shall be drip-proof, 40 degree C rise, 3 phase, NEMA Design B type motors.

PART 3 EXECUTION

3.1 IDENTIFICATION

A. All vacuum piping to be stenciled with name of gas, direction of flow, operating pressure, and pipe size. Stenciling to be spaced not more than 20 feet intervals and at least once in each room and each story traversed by the piping system.
3.2 INSTALLATION

A. Copper pipe, tubing, valves, and fittings shall be pre-cleaned and prepared for medical gas service in accordance with NFPA 99, except those supplied especially prepared for such service by the manufacturer and received sealed on the job.

B. Joints in all the vacuum piping except those at equipment requiring screwed connections, shall be made with silver brazing alloy or similar high melting point (at least 1000 degrees F) brazing metal. Silver brazing material for pipes and fittings in the medical gas system shall be Stay-Silv-15 or equal to the following: Silvaloy-15, Aircosil No. 15, or Phos-Silver-15. The silver brazing alloy shall contain a minimum of 15% silver, 80% copper, and 5% phosphorus and shall not contain cadmium alloy. The silver brazing alloy shall have a minimum of 1000 degrees F. liquidus melting point and shall have an ASTM rating of "BCuP5". The use of flux is prohibited from the making of joints between copper to copper pipes and fittings. Appropriate flux similar to "Stay-Silv-black Flux" or "Stay-Silv-White Flux" is required between dissimilar metals such as copper to brass or bronze material, when parts are heated over a prolonged period. During the brazing of pipe connections, the interior of the pipe shall be purged continuously with nitrogen. The outside of the tube and fittings shall be cleaned by washing with hot water after assembly.

C. All piping shall be supported with pipe hangers or strut systems at intervals per NFPA 99, and NOT supported by other piping. Isolation of all copper piping from dissimilar metals shall be of a firm, positive nature. Duct tape is not acceptable as isolation material.

1. Hanger Spacing shall be as follows:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Hanger Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 inch</td>
<td>6 feet</td>
</tr>
<tr>
<td>3/4 inch</td>
<td>7 feet</td>
</tr>
<tr>
<td>1 inch</td>
<td>8 feet</td>
</tr>
<tr>
<td>1-1/4 inch</td>
<td>9 feet</td>
</tr>
<tr>
<td>1-1/2 inch and larger</td>
<td>10 feet</td>
</tr>
</tbody>
</table>

D. Install screw joints used in shutoff valves, including station outlet valves, by tinning the male thread with soft solder. Litharge and glycerin or an approved oxygen luting or sealing compound are acceptable.

E. Piping exposed to physical damage shall be adequately protected.

3.3 PRESSURE TESTING

A. After installation of the piping and valves, but before installation of the service outlets, the line shall be blown clear by means of oil-free, dry air or nitrogen.

END OF SECTION 22 10 10
SECTION 22 11 23 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

PART 2 - PRODUCTS

2.1 HOT WATER RECIRCULATING PUMP

A. Acceptable manufacturers: Taco, Aurora, or Bell and Gossett.

1. Model number, capacity, accessories, and electrical characteristics as scheduled on drawings.

B. Provide in-the-line pump, all bronze construction, flange connections, hardened steel shafts, bronze sheathed, diamond bared, sleeve bearings, bronze impellers, and mechanical seals.

C. Provide flexible coupled motor, supported from pump casing and manual motor starter complete with thermal overload protection.

D. Provide operating and maintenance instructions.

PART 3 - EXECUTION

3.1 PUMP INSTALLATION

A. Verify location and clearance requirements.

B. Install in accordance with manufacturer's recommendations.

C. Hot water recirculating pumps

1. Provide factory representative or manufacturer's service representative to verify proper installation, operation and performance as specified.

D. Install piping adjacent to pump to allow service and maintenance.

E. Install shut off valve on suction side of pump.

END OF SECTION 22 11 23
SECTION 22 14 23 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
   1. Roof drains.
   2. Miscellaneous storm drainage piping specialties.
   3. Channel drainage systems.
   4. Flashing materials.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE
A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CHANNEL DRAINAGE SYSTEMS
A. Polymer-Concrete, Channel Drainage Systems:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. ACO USA.
      b. Mea-Josam Div.
      c. Polycast Hubbell Power Systems, Inc.
   2. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
      a. Channel Sections: Wide, interlocking-joint, precast, polymer-concrete modular units with end caps. Include flat or rounded bottom, with level invert and with outlets in number, sizes,
and locations indicated. Pre-cast units shall be manufactured with neutral invert and have a wall thickness of at least 1/2-inch. Each unit will feature a male to female interconnecting end profile. Units shall have horizontal cast in anchoring features on the outside wall to ensure maximum mechanical bond to the surrounding bedding material and pavement surface. The galvanized steel edge rail will be integrally cast in by the manufacturer to ensure maximum homogeneity between polymer concrete body and edge rail. Each edge rail shall be at least 1/8-inch thick. Basis of design product is SlabDrain (H100-8) manufactured by ACO Drain, 4211 Pleasant Road, Fort Mill, SC 29078, 800-543-4764.

1) Dimensions: 4-inch (203-mm) inside width. Include number of units required to form total lengths indicated.
2) Frame: Galvanized steel or gray iron for grates.

b. Grates: Manufacturer's designation "medium duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.

1) Material: Galvanized steel.
2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

c. Covers: Solid ductile or gray iron, of width and thickness that fit recesses in channel sections, and of lengths indicated.
d. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.2 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness).

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness unless otherwise indicated. Include G90 (3.275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.

B. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install horizontal backwater valves in floor with cover flush with floor.

F. Install test tees in vertical conductors and near floor.

G. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

H. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. (30-kg/sq. m) lead sheets, 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of 4.0-lb/sq. ft. (20-kg/sq. m) lead sheets, 0.0625-inch (1.6-mm) thickness or thinner.

2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches (250 mm) and with skirt or flange extending at least 8 inches (200 mm) around pipe.

2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.

3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.
D. Secure flashing into sleeve and specialty clamping ring or device.
E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 14 23
SECTION 22 33 00 - WATER EATERS - ELECTRIC

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide a factory packaged, electric storage type domestic water heater.

PART 2 - PRODUCTS

2.1 ELECTRIC, DOMESTIC-WATER HEATER

A. Electric, Storage, Domestic-Water Heater:

2. Storage-Tank Construction: Steel.
   b. Pressure Rating: 150 psig.
   c. Interior Finish: Comply with NSF 61 Annex barrier materials for potable-water tank linings, including extending lining material into tappings.

3. Factory-Installed Storage-Tank Appurtenances:
   a. Anode Rod: Replaceable magnesium.
   b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
   c. Drain Valve: ASSE 1005.
   d. Insulation: Comply with ASHRAE 90.2.
   e. Jacket: Steel, cylindrical, with enameled finish.
   f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
   g. Heating Elements: Two; electric, screw-in immersion type; wired for nonsimultaneous operation unless otherwise indicated. Limited to 12 kW total.
   h. Temperature Control: Adjustable thermostat.
   i. Safety Control: High-temperature-limit cutoff device or system.
   j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tank:

1. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
2. Construction:
   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
   b. Interior Finish: Comply with NSF 61 Annex barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 (DN 20) with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.


E. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Domestic-Water Heater Mounting: Install electric, domestic-water heater on floor.

B. Install electric, domestic-water heater level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

   1. Install shutoff valves on domestic-water-supply piping to domestic-water heater and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 221005 "Plumbing Piping & Valves," for ball valves.

C. Install combination temperature-and-pressure relief valve in top portion of storage tank. Use relief valve with sensing element that extends into tank. Extend water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install water-heater drain piping as indirect waste to spill by positive air gap into open floor drain. Install hose-end drain valves at low points in water piping for electric, domestic-water heater that do not have tank drains.

E. Install thermometer on outlet piping of electric domestic-water heater.

F. Charge domestic-water compression tank with air.
3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221005 "Plumbing Piping & Valves." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heater, allow space for service and maintenance of water heater. Arrange piping for easy removal of domestic-water heater.

END OF SECTION 22 33 00
SECTION 23 05 00 - GENERAL PROVISIONS FOR HVAC

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Conform to the following:

2. International Mechanical Code - 2006

1.2 STANDARDS

A. Comply with all pertinent standards.

1. AMCA: Air Moving and Conditioning Association
3. ASHRAE: American Society of Heating Refrigeration and Air Conditioning Engineers.
4. ASME: American Society for Mechanical Engineers.
5. NEMA: National Electrical Manufacturer's Association.
7. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.
8. UL: Underwriters' Laboratories, Inc.

1.3 SUBMITTALS

A. Submit under provisions of Division 01.

1. Submit complete descriptions, specification data for material and equipment proposed. Clearly indicate proposed items when other items are shown on same sheet.
2. Submittals in 3-ring binders shall include an index of contents and divider tabs.
3. Shop Drawings:

   a. Control System
   b. Chiller
   c. Air Handling Equipment
   d. Air Terminal Units
   e. Fan Coil Units
   f. Air Distribution, Ductwork, Grilles, Registers
   g. Insulation
   h. Filters
   i. Vibration Isolation
   j. Pumps and Hydronic Specialties
   k. Underground Steam Distribution System
l. Steam/Hot Water Heat Exchanger
m. VFD's
n. Motors
o. Fans
p. Fire Dampers
q. Valves, Traps and Strainers
r. Water Treatment System

1.4 ADHESIVES AND SEALANTS

A. Adhesives, sealants, and sealant primers used inside the building (defined as inside the weatherproofing envelope and applied on site) shall comply with SCAQMD Rule 1168-2005 for volatile organic compound content limits.

B. Aerosol adhesives shall comply with GS 36-2011 for volatile organic compound content limits.

1.5 REGULATORY REQUIREMENTS

A. Perform Work specified in Division 23 in accordance with standards listed below of the latest applicable edition adopted by the authority having jurisdiction. Where these Specifications are more stringent, they shall take precedence. In case of conflict, obtain a decision from the Architect.

3. ANSI Handicapped Code-A117.1
4. IBC: International Building Code, with Mechanical and Plumbing Codes.
5. Special regulations, supplement, and amendments of the State and/or local authorities having jurisdiction.

B. Comply with the applicable edition date of each regulation as adopted by the authorities having jurisdiction.

1.6 CONTINUITY OF EXISTING SERVICE AND SYSTEMS

A. Schedule work so existing systems will not be interrupted when they are required for normal usage of the existing building. Obtain approval from the Owner and Architect at least 7 days prior to any utility interruption or connection.

B. Perform work at such time and in such manner as to cause minimum inconvenience to the Owner and as approved by the Architect. No allowance will be made for lack of knowledge of existing conditions.
1.7 PROJECT/SITE CONDITIONS

A. Layouts indicated on drawings are diagrammatical and intended to show relative positions and arrangement of equipment, ductwork and piping. Coordinate mechanical work with other trades and measurements obtained at the job site, as applicable, prior to installation. Generally, install work in locations shown on Drawings, using as necessary, rises, drops, offsets, transitions, and alternate routings to fit in the available space unless prevented by Project conditions.

1.8 COMPLETENESS OF WORK

A. The Contract Documents depict HVAC systems which are intended to be complete and functioning systems. All products, materials, and labor necessary to render a fully functional system to fulfill the design intent shown on the documents shall be provided by the Contractor.

B. Catalog numbers referenced throughout the Division 23 Drawings and Specifications are intended to convey a general understanding of the type and quality of the product required. Where written descriptions differ from information conveyed by a catalog number, the written description shall govern. No extra shall be allowed because a catalog number is found to be incomplete or obsolete.

1.9 RECORD DRAWINGS

A. Provide record drawings that illustrate the work of Division 23 as finally constructed. Provide dimensions of material installed below slab/grade from fixed and visible reference points. Deliver record drawings to the architect in a form suitable for production.

B. Record drawings shall reflect all changes made to the Contract Documents, whether generated by addenda, change orders, or field conditions. Maintain a daily record of these changes and keep current set of drawings showing these changes.

C. Deliver record drawings to Architect within 30 days of Substantial Completion.

1.10 OWNER AND OPERATING MANUALS

A. Comply with the requirements of Division 01, but provide a minimum of three sets, in three ring binders, all sets identical.

B. Manuals shall include clear and comprehensive operating instructions with appropriate graphics and project specific marked data to enable owner to operate and maintain all systems specified in this Division.

C. Copies of approved submittals on furnished equipment shall be included.
PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS

A. Hangers:
   1. General: Complete with rods and supports proportioned to the size of piping or equipment to be supported.
   2. For steel pipe: Steel or malleable iron, unless specified otherwise herein.
   3. For heating water, steam and condensate piping 3" and larger: Anvil 171, B-Line B3114, or ERICO 605 roll type with Anvil 160, B-Line B3160, or ERICO 630 pipe covering protection saddles.
   4. For copper piping: copper-plates; Anvil CT-69, B-Line B3170 CT, or ERICO 101.
   5. For chilled water: galvanized, Anvil 260, B-Line B3100, or ERICO 401.

B. Hanger Rods:
   1. One-piece steel type, threaded as required.
   2. Sizes, unless specified otherwise herein, shall be as follows:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Rod Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot; and smaller</td>
<td>0.375&quot;</td>
</tr>
<tr>
<td>2.5&quot; and 3&quot;</td>
<td>0.5&quot;</td>
</tr>
<tr>
<td>4&quot;</td>
<td>0.625&quot;</td>
</tr>
<tr>
<td>6&quot;</td>
<td>0.75&quot;</td>
</tr>
<tr>
<td>10&quot;-12&quot;</td>
<td>0.875&quot;</td>
</tr>
<tr>
<td>14&quot;-18&quot;</td>
<td>1.0&quot;</td>
</tr>
</tbody>
</table>

   3. Sizes for gang or multiple hangers: Calculated for the combined weight of the piping and accessories.
   4. Sizes for equipment hangers: Calculated for the weight of the equipment supported.

C. Inserts:
   1. Adjustable type: Anvil 282, B-Line B3014, or ERICO 355.
   2. Continuous type: Anvil PS-5000, B-Line B321, or ERICO CON.

D. Expansion Anchors:
   1. In concrete: Wedge, self-drilling, or drilled flush type.
   2. In masonry: Sleeve type.
   3. Manufacturer: Hilti, ITW Ramset/Red Head, or Rawl.

E. Insulation Protectors: Anvil 167, B-Line B3151, or ERICO 125.

F. Channel strut systems: 14 gauge minimum galvanized steel, with factory-punched attachment holes. Straps shall be designed so that the attachment nut is captive on the shoulder of the strap when tightened. Attachment nuts shall be designed to provide a surface on the turned down edge while making positive contact with the side walls of the channel. Nuts, bolts, straps, and accessories shall be protected with same finish as channels.
1. Manufacturer: B-Line, Kindorf, Midland-Ross, or Unistrut.

G. Pipe Stand Supports:

1. For chilled water piping: adjustable pipe saddles, stanchion type with locknut nipple, reducer, flange and baseplate. Provide U-bolt yoke for pipe 12” and smaller.
   a. Manufacturer: Anvil 264, B-Line B3093, or ERICO 723.

2. For heating water, steam and steam condensate piping: Adjustable pipe roll stands with baseplate.

2.2 EQUIPMENT SUPPORTS

A. Structural steel for supports: ASTM A36.

1. Use galvanized members installed in fan plenums or areas of high humidity or condensation, and outside.
2. Furnish other members with shop coat of red primer.
3. Retouch primer after field welding.

2.3 FLASHINGS AND COUNTERFLASHINGS

A. Furnish materials and coordinate installation for flashing and counterflashing roof penetrations for vents, pipe, drains, and ducts.

PART 3 EXECUTION

3.1 EXCAVATING AND BACKFILLING

A. Provide trenching, excavating, and backfilling necessary for performance of mechanical work in accordance with Division 02.

3.2 CUTTING AND PATCHING

A. Repair or replace damage caused by cutting or installation of work specified in Division 23.

B. Perform repairs with materials which match existing and install in accordance with the appropriate section of these specifications.

3.3 FLASHING AND COUNTERFLASHING

A. Counterflash ducts and pipes where penetration of roofs and outside walls occur.
3.4 DELIVERY, STORAGE, AND PROTECTION

A. Insofar as possible, deliver items in manufacturer’s original unopened packaging. Where deliver in original packaging is not practical, provide cover and shielding for all items with protective materials to keep them from being damaged. Use care in loading, transporting, unloading, and storing to keep items from being damaged.

B. Store items in a clean, dry place, and protect from damage. Mechanical equipment may not be staged or stored outdoors unless intended for outdoor use.

C. Protect nameplates on motors, pumps, and similar equipment. Do not paint or insulate over nameplate data.

D. Protect valves and piping from damage. Cover equipment during work of finishing trades.

E. Keep dirt and debris out of pipes and ducts.

F. Repair, restore, and replace damaged items.

G. Cover factory finished equipment during work of finished trades, such as fan coils, fin tubes, etc.

H. Protect cooling and/or heating coils with temporary filter media during construction.

3.5 OPERATION OF HVAC SYSTEMS DURING CONSTRUCTION

A. Install specified filters prior to system operation. In addition to specified filters, install a roughing filter upstream of mixed air filter. Roughing filter shall consist of two layers of roll filter media clipped and sealed to entering side of filter frame (MERV 8 minimum). Change roughing filter as necessary to minimize dust collection on specified filters.

B. Cover and return and exhaust air grilles with temporary filter media (MERV 8 minimum). Attach media to avoid damage to grille or ceiling. Change temporary media as required to protect against dust buildup on ductwork. Remove temporary media from grilles after flooring is installed, walls are sanded and painted and other dust generating construction has been completed.

C. During period of excessive dust generation such as drywall sanding, seal off return and exhaust openings and grilles to prevent dust from accumulating in ductwork.

D. If outside air source contains less dust than building air, adjust A/C unit dampers to operate with as much outside air as possible without causing a freezing conditions for coil or exceeding capacity of coil to adequately condition supply air.

E. Furnish and install a new set of specified filter media prior to start of system test and balance. Furnish a new, clean set of the specified media and turn over to Owner’s Representative.

3.6 EQUIPMENT GUARDS

A. Use suitable structural frames with minimum 12 gauge, 3/4" galvanized mesh, or expanded metal mesh. Attach to equipment by removable clips and bolts with wing nuts, or other approved connectors.
B. At belts, provide opening for measuring RPMs.
C. Provide at all belts, couplings, moving machinery and equipment.
D. Design for easy access to belts and other items required replacement.
E. Comply with OSHA regulations.

3.7 CLEANING HVAC SYSTEMS

A. General Cleanup:
   1. Upon completion of contract and progressively as work proceeds, clean up dirt, debris, oil materials, etc., and remove from site, keeping premises in neat and clean condition to satisfaction of the Architect.
   2. Seepage, discoloration or other damage to parts of the building, its finish, or furnishings due to Contractor's failure to properly clean piping systems or duct systems shall be repaired without cost to the Owner.

B. Factory Finishes:
   1. Clean items with factory finishes. Touch up bare places, scratches and other minor damage to finishes. Use only factory supplied paint of matching color and formula. If finishes are badly damaged or if there are many damaged, scratched or bare places, refinish the entire item.

C. Ducts and Apparatus:
   1. Thoroughly clean ducts and apparatus casings before fans and filters are operated.

D. Steam and steam condensate system:
   1. Thoroughly blow out system and clean it by using steam under pressure of 5 psig. Allow condensate to be wasted to drains for a period of at least 8 hours. Cool condensate to 140 degree F maximum prior to discharge.

3.8 CLEANING

A. Thoroughly clean ductwork and equipment casings before fans and filters are operated.

B. Repair damaged factory finishes covering all bare places and scratches.

C. Cleaning HVAC Systems Water Piping:
   1. Clean all equipment and piping of iron cuttings and other foreign matter as they are installed.
   2. Thoroughly flush HVAC water systems with precleaning chemicals designed to remove depositions such as pipe dope, oils, rust, mill scale, and other extraneous materials. Provide dosages of precleaner chemicals recommended by water treatment supplier and add and circulate throughout the water systems. Drain, refill, and flush water systems thoroughly until no foreign matter is observed and total alkalinity of the drain water is equal to that of the make-up water.
3. Do not install devices in which foreign matter could become lodged such as control valves, until cleaning and flushing are completed. Position valves to bypass chiller, boiler and heat exchanger. Connect supply and return runouts together at each coil location. Make connection of supply and return runouts with short lengths of high pressure rubber hose and brass fittings. One fitting shall be swivel type to eliminate turning fitting in hose.

4. Fill system at city water make-up connection with all air vents open. After filling, close vents.

5. Start main pump with pressure reducing valve makeup open. Check vents in sequence to bleed off any trapped air in order to assure circulation through all components of system. Verify pumps are properly aligned and bolted down before start-up to prevent damage to seals or couplings. Circulate water for at least two hours and then drain completely to flush out foreign matter.

6. Remove, clean, and replace all strainer baskets. Clean all dirt legs. If indications are found of excessive dirt, repeat the above flushing.

7. Fill the system with fresh water, adding precleaning chemicals designed to remove depositions such as pipe dope, oils, rust, mill scale, and other extraneous materials. Provide dosages of precleaner chemicals recommended by water treatment supplier. Alternate operation of primary and standby pumps, and circulate the cleaning solution for 24 hours. Then turn off the pump and completely drain the system.

8. Remove, clean, and replace all strainer baskets. Clean all dirt legs. Replace suction diffuser start-up strainer with conventional strainer. Refill the system with clean water, venting all high points and equipment of air and gases. Bring water systems to operating temperature. Recheck all vent points during this process and remove all air.

9. After the system has been completely cleaned, test system by litmus paper or other dependable method and leave system on slightly alkaline side (ph 7.5 to 8.5). If system is still on acid side (ph 7.0 or lower), add water conditioner.

D. Cleaning Steam Supply and Steam Condensate Return Systems: Thoroughly clean using 5 psig steam allowing condensate to be wasted to drains for 8 hours.

3.9 TESTING MECHANICAL SYSTEMS

A. Test all systems and equipment installed to demonstrate proper operation.

B. Advise Architect of scheduled systems testing and completed system demonstration/operation schedules so that he may witness, if desired.

C. Correct and retest work found defective when tested.

D. Make repairs to piping systems with new materials. Peening, doping, or caulking of joints or holes will not be acceptable.

E. HVAC Circulating Water Piping: Hydrostatically test piping at 150 psig pressure or at 1-1/2 times design pressure as indicated on drawings, whichever is greater, for a period of six hours without evidence of leaking.

F. Steam and Steam Condensate Piping: Hydrostatically test piping at 150 psig pressure or 1-1/2 times design working pressure for a period of six hours without evidence of leaking.
G. Records of Testing: Maintain records of system testing and results thereof. Deliver results as part of project closing file and on an intermediate basis as requested by Architect.

END OF SECTION 23 05 00
PART 1 - GENERAL

1.1 GENERAL
A. Provide all labor, materials, tools, and services required; maintain warranties and keep equipment in operating condition.

B. Principal equipment included are:

1. Chiller
2. Heat Exchanger
3. Pumps
4. Air Handling Units
5. Fan Coil Units
6. Variable Air Volume Boxes
7. Variable Frequency Drives (VFD)
8. Water treatment system
9. Fans
10. Air Distribution Devices
11. Control System

C. No mechanical equipment shall be operated until the equipment has been started, approved and signed off by the equipment's respective supplier.

D. Air handlers shall be operated only in areas where painting and ceiling work is in progress. Air handlers shall not be operated when concrete grinding or drywall finishing is in progress.

E. When an air handler is placed in service, pre-filters shall be changed on a weekly basis. The Contractor shall maintain logs showing when filters are changed.

F. Air handlers shall not be operated over 30 Hz until factory start up is complete and copies of the start up report are provided to the Designer for approval.

G. The chillers shall not be operated until factory start up is complete and copies of the start up report are provided to the Designer for approval.

H. After start up of the chillers, the contractor shall visit the site at least three times a day to inspect and fill out Owner's equipment logs.

I. The chillers shall not be operated until the water treatment systems are fully functional.

J. The steam/hot water heat exchanger and hot water system shall not be operated until the water treatment system is fully functional.

K. If air handling units are used during construction, filtration media with a minimum efficiency of MERV8 shall be used at each return grille.
L. Protect all HVAC equipment from both dust and odors.

M. Seal all duct and equipment openings with plastic. Protect the return/negative pressure side of all systems. Install and maintain (replace weekly) temporary filters over grilles and openings. The temporary filters shall have a rating of MERV8 or better.

1.2 CLEANING

A. Thoroughly clean ductwork, equipment casings, coils and VAV boxes and replace filters before turning equipment over to the Owner. Units having visible signs of construction dust will not be accepted.

B. Repair damaged factory finishes covering all bare places and scratches.

C. Thoroughly clean chilled water and hot water systems before system is turned over to the Owner.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION - NOT APPLICABLE

END OF SECTION 23 05 05
SECTION 23 05 13 - MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUBMITTALS
   A. Submit motor information with submittals and shop drawings.

1.2 REFERENCE STANDARDS
   A. All equipment and material furnished and installed on this project shall be UL or ETL listed in accordance with the requirements of the authorities having jurisdiction and suitable for its intended use on this project.

PART 2 - PRODUCTS

2.1 MOTORS
   A. Acceptable manufacturers: MagneTek or Lincoln.
   B. In general, motor voltages shall be as follows, unless specified or indicated otherwise:
      1. 3/4 hp and larger: 208V or 460V, three (3) phase, 60 hertz (reference drawings)
      2. Smaller than 3/4 hp: 120V, one (1) phase, 60 hertz
   C. All motors shall be started across the line, unless specified otherwise. Motors shall be selected with low starting current and shall be designed for continuous duty to provide the running torque and pull in torque required to suit the load. Unless otherwise indicated on the Contract Documents, all motors shall be single speed (1750 rpm). All motors shall have standard open drip proof enclosures unless otherwise specified. All motors exposed to the actually installed outside in the weather shall be of the totally enclosed fan cooled (TEFC) or totally enclosed air over (TEAO) types. All motors not utilized with variable speed drives shall have a minimum service factor of 1.15 and shall be selected to operate at design conditions without exceeding their nameplate rating (without exploiting the service factor rating). Motors used in conjunction with variable speed drives shall have a 1.00 service factor unless otherwise indicated and be compatible with the drive and rated for inverter output duty.
      1. Standard open drip proof three (3) phase motors ten (10) horsepower and smaller shall have cast aluminum end bells with steel frames. Three (3) phase motors fifteen (15) horsepower and larger shall have cast iron end bells and housings.
      2. Standard open drip proof single phase motors shall have cast aluminum end bells with steel frames.
      3. Totally enclosed fan cooled (TEFC) and totally enclosed air over (TEAO) three (3) phase motors shall have cast iron housings. TEFC motors shall have corrosion resistant fans.
   D. Windings and Insulation:
      1. All motors shall have copper windings.
2. Motors shall be equipped with Class B, 80°C rise or Class F, 105°C rise insulation suitable for use in a 40°C ambient temperature. Windings shall be treated with an epoxy varnish to inhibit the absorption of moisture.

E. Bearings:

1. Single phase, fractional horsepower motors shall be equipped with quiet operating, all angle, babbitt lined sleeve bearings.
2. Polyphase motors shall be equipped with deep groove type ball bearings, generously sized for the loads to which applied and for severe duty application. Provide the necessary seals on the shaft to keep the bearing system free of contamination and moisture. Lubricant shall be high temperature, nonbleeding grease.
   a. Provide inlet and outlet plugs on poly-phase motors so that grease fittings can be easily inserted for bearing relubrication except as otherwise specified. The end shields shall be carefully machined to add extra grease capacity. Lower outlet plugs shall be equipped with combination breather/drains on TEFC and TEAO motors.

F. Motors shall be specifically designed for quiet operation and for severe duty. Standard open drip proof motors shall be equipped with aluminum or stainless steel stamped nameplates. Totally enclosed fan cooled and air over motors shall be equipped with stainless steel stamped nameplates with either zinc or cadmium plated hardware. Motor nameplates shall clearly indicate frame size, horsepower, frequency, voltage, speed, starting torque class, insulation class, service factor and winding material.

G. Motors on belt driver equipment shall have slide rails with adjusting screws for belt tension adjustment. Motors exposed to the weather shall be weather protected.

H. Motors specified with variable frequency drive controllers shall be inverter duty rated and shall be insulated against eddy currents.

I. Install premium efficiency electric motors for motors 1 horsepower and above. Premium efficiency motors shall have efficiency and losses determined in accordance with the latest revisions of IEEE Standard 112. Polyphase squirrel-cage motors rated 1 through 125 horsepower shall be tested by dynamometer method B. The efficiency will be determined using segregated losses in which stray load loss is obtained from a linear regression analysis to reduce the effect of random errors in the test measurements. Guaranteed minimum load efficiency shall be as follows:

1. HP: 3/4 Eff: 80%
2. HP: 1 Eff: 84%
3. HP: 1-1/2 Eff: 86.5%
4. HP: 2 Eff: 86.5%
5. HP: 3 Eff: 89.5%
6. HP: 5 Eff: 89.5%
7. HP: 7-1/2 Eff: 91.7%
8. HP: 10 Eff: 91.7%
9. HP: 15 Eff: 93.0%
10. HP: 20 Eff: 93.6%
11. HP: 25 Eff: 93.6%
12. HP: 30 Eff: 94.1%
13. HP: 40 Eff: 94.5%
14. HP: 50 Eff: 95.0%
15. HP: 60 Eff: 95.4%
16. HP: 75 Eff: 95.4%

J. Sound power levels not greater than recommended in NEMA M61-12.49. VFD duty rated motors shall not increase by more than 3 dB when operating on VFD.

K. Provide motors with drive shafts long enough to extend completely through belt sheaves when sheaves are properly aligned or balanced.

2.2 STARTERS

A. Starters shall be as manufactured by Square D or approved substitute.

B. Starters used on 208-volt systems shall have two cartridge fuses in the control circuit.

C. Starters used on 480-volt systems shall have an individual 480/120-volt control transformer with two cartridge fuses in the primary and one in the secondary.

D. All starters to be provided with melting alloy overloads.

E. Starters used inside shall have NEMA 1 enclosures; starters used in damp locations or exposed to the weather to have NEMA 3R enclosures.

F. Manual Motor Starter with Heater Unit: Square D Class 2510.

G. Provide starters with disconnect switch.

H. Starters mounted in motor control center are specified under Division 26.

I. Single speed motors 25 horsepower and larger to have power factor correction capacitors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Arrange and set motors.

B. Line up motors on direct drive equipment using dial type gauges.

C. Make connections and test motor for proper rotation/phasing under Division 26.

3.2 ADJUSTMENTS

A. Motors, together with driven equipment, shall be dynamically and statically balanced. Imbalance shall be reduced to minimum specified by equipment manufacturers.

B. Fan vibration should be limited to manufacturer's recommendations, but should not exceed 2 mils in any case.

END OF SECTION 23 05 13
PART 1 - GENERAL

1.1 GENERAL
   A. Furnish complete variable frequency motor controllers (VSMC) for fans and pumps designated.

1.2 WARRANTY
   A. The VSMC shall be warranted by the manufacturer for a period of 36 months from date of start-up. The warranty shall include parts and labor.
   B. During warranty period, any warranty expense shall be borne by the manufacturer, including travel costs or living expenses necessary to repair in warranty equipment.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
   A. ABB or approved equal.

2.2 DRIVE TECHNOLOGY
   A. Solid state design to transform input power into frequency and voltage controlled 3-phase output power suitable to provide positive speed and torque control to standard induction motors.
   B. Front end: Input line filters as integral part of drive.
   C. Invertor section: Transistorized sinecode pulse width modulation. Employ power transistors in the invertor without paralleling.
   D. Power factor: Minimum of .95 and an efficiency of 95% at 100% full output.
   E. Increase in audible motor noise with drive operating shall not exceed 3 decibels.

2.3 EQUIPMENT REQUIREMENTS
   A. Enclosure: NEMA 1 enclosure with deadsides for installation in an individual wall installation.
   B. Input disconnect: Integral, magnetic trip only circuit breaker or non-fused switch.
C. Ratings:
1. Provide symmetrical A/C rating of 100,000 amps for fused input drives.
2. Provide symmetrical A/C ratings of 50,000 amps for other than fused input drives at 460 volts and 35,000 amps for other than fused inputs at lower voltages.
3. Provide higher ratings where available fault current exceeds these levels and as called for on drawings.

D. Provide an integral bypass contactor for operation of motor at constant speed, electrically independent of the inverter. Include motor overload protection when in bypass mode. Include necessary control relays and switches to allow automatic controls and safeties to operate when drive is in bypass mode.

E. Features and Specifications:
1. Horsepower Rating: As scheduled on drawings.
2. Input power: 460 VAC ± 10%, 60 HZ ± 3%.
3. Output power: 0-460 volts, 1-60 HZ.
4. Ambient temperatures:
   a. Drive operating: 32 degrees F. to 104 degrees F.
   b. Drive storage: 68 degrees F. to 140 degrees F.
5. Output Frequency Stability: Shall not vary with load, temperature or with ± 10% input frequency variations.
6. The VSMC shall include a plug-in test meter for monitoring the different signals within the VSMC for start up and troubleshooting.

F. Speed Control:
1. The output frequency may be adjusted in proportion to any one of the following:
   a. 0-10 VDC Analog Signal.
   b. 0-5 VDC Analog Signal.
   c. 4-20 MA DC Analog Signal.

G. Start-Stop Control: Drive may be started or stopped by any one of the following:
1. A contact closure.
2. Use of a motor starter or contactor in the input power line.
3. The speed control signal dropping below or rising above minimum.
4. An external 115 VAC signal.

H. Customer Contacts: Single pole, double throw contact which changes state on trip condition.

I. 115 Volt AC Power Supply: Used to provide a remote enabled indication.

J. Building Automation System Interface: Provide VFD interface to duplicate all points monitored locally at VFD into the BAS. Interface shall connect to BAS network communication bus.
2.4 SELF PROTECTION AND RELIABILITY FEATURES

A. Current Limit: Limit output current to 110% of inverter rating.

B. Instantaneous Overcurrent Trip: Limit output current in under 50 microseconds due to phase-to-phase short circuits or severe overload conditions.

C. Undervoltage Trip: Protect the inverter due to voltage levels in excess of its rating. Activates automatically when the DC bus in the controller exceeds 1000 VDC.

D. Overtemperature Trip: Protect the inverter from elevated temperatures in excess of rated temperatures.

E. Automatic Reset/Rerstart:
   1. Automatic reset on trip condition resulting from overcurrent, undervoltage, overvoltage, or overtemperature after removal or correction of the causative condition.
   2. Provide unlimited number of reset/restarts for undervoltage, overvoltage, and overtemperature.
   3. Limit the number of reset/restarts for overcurrent and require manual reset.

F. Isolation: Isolated current and voltage signals from logic circuitry.

G. Drive Logic: Microprocessor based.

H. Sustained Power Loss: In the event of a sustained power loss, shut down without component failure. Upon return of power, automatically return drive to normal operation if the start is in the "ON" condition.

I. Momentary Power Loss: In the event of a momentary power loss, shut down without component failure. Upon return of power, automatically return drive to normal operation, if the start is in the "ON" condition, being able to restart into a rotating motor regaining positive speed control without shutdown or component failure.

J. Short Circuit Protection: In the event of a phase-to-phase short circuit, shutdown safely without component failure.

K. Power Interruption: In the event that an input or output power contactor is opened or closed while the drive is activated, no damage to the control shall result.

L. Critical frequency avoidance circuit: Minimum of six user selectable bands to avoid operation at speeds which cause excessive vibration or noise in the driven equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and connect equipment in locations specified on Contract Drawings in strict accordance with the manufacturer's instructions.

B. Provide materials and assistance as required by the manufacturer's representative.

C. Coordinate installation with requirements for HVAC temperature controls.
D. Electrical:
1. Control systems, components and control and interlock wiring for mechanical equipment will be furnished under this division.
2. Provide power wiring to drives under Division 26. Power wiring shall consist of wiring to the line side terminals wiring away from the load side terminals to the equipment, except where such wiring is installed pre-wired by the equipment vendor such as for chiller units.
3. Fire alarm control wiring among duct mounted smoke detectors, fire alarm system, drives, ATC panels DDC panels shall be furnished under Division 28.

E. Label enclosures with engraved plastic nameplate describing the equipment served, e.g. "AHU-1". Nameplates shall be attached with screws or rivets. Adhesives shall not be used to secure the nameplates.

3.2 START-UP, TESTING, DEMONSTRATION
A. Provide a factory trained technician to supervise the installation, start-up and testing of drives. As a minimum, check the following items:
   1. Motor voltage and frequency.
   2. Control input and automatic start/stop.
   3. Calibration and adjustment for minimum and maximum speed set points and acceleration and deceleration rates.

B. Provide a minimum of one day (8 hours) instruction to maintenance personnel.

C. Demonstrate the operation of the system to the maintenance personnel.

D. Provide the necessary coordination for test and balance procedure as required by Section 23 05 93.

END OF SECTION 23 05 14
SECTION 23 05 17 - SLEEVES, ESCUTCIONS, AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL (Not Applicable)

PART 2 - PRODUCTS

2.1 SLEEVES

A. Sleeves shall be standard weight steel pipe except sleeves for concealed piping through floors not in structural members, and through interior drywall construction may be formed from 26 gauge galvanized sheet metal lapped and pop riveted.

2.2 EXTERIOR WALL - SLEEVE-SEAL SYSTEMS

A. Exterior Wall & Steam Vault Penetration System by Link-Seal or approved equal.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2. Pressure Plates: Carbon steel.

3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVES

A. Materials

1. Concrete floors, concrete and masonry walls: 18 gauge galvanized sheet metal.

2. Drywall partitions: 18 gauge galvanized steel sheet metal.

B. Sleeves shall be sized such that the annular space between outside surface of pipe or pipe insulation and the inside surface of the sleeve is not less than 1/2". Provide larger annular space if required by firestopping product installation instructions.

C. Sleeves supporting riser piping 4" and larger shall have three 6" long reinforcing rods welded radically at 120 degree spacing to the sleeve and shall be installed with the rods embedded in the concrete slab.

2.4 PENETRATION SEALS

A. Refer to architectural specification for Fire Safing.
2.5 GROUT

A. Non-shrink type, conforming to ASTM C1107/C1107M-2013 when tested at fluid consistency. Grout shall exhibit zero bleeding at every age when mixed to fluid consistency. Minimum 28 day compressive strength, when mixed to fluid consistency, shall be 7000 psi.

B. Manufacturer: Cormix or Master Builders.

2.6 ESCUTCHEON PLATES

A. Provide chromium plated escutcheon plates for exposed, uninsulated pipes projecting through floors or walls in "finished" spaces. Mechanical rooms, store rooms, electrical closets and janitor closets are not considered "finished" spaces.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

1. Piping requiring sleeves:
   a. Heating hot water
   b. Chilled water
   c. Copper pipes thru masonry walls

B. Where a pipe requiring sleeves passes through a wall, ceiling or floor slab, a steel sleeve shall be provided and the internal diameter of the sleeve shall be 2” larger than the external diameter of the pipe or insulated pipe passing through it. After all the piping is installed in that area, the Contractor shall check the clearance and correct it, if necessary to within 1/2”. Then the void shall be packed full depth with glass/mineral fiber and sealed at both ends, 1” deep with sealant backed by foam rod. Nothing in these paragraphs shall override the fire penetration details shown on the drawings.

C. Pipe sleeves shall be provided at non-rated partitions and floor penetrations. Pipe sleeves to be Schedule 40 or 18 gage steel. Sleeves to extend 1-1/2” in excess of partition depth on each side. Sleeves penetrating floors in wet areas, including all mechanical rooms, shall extend a minimum of 1 inch above the floor.

   1. Sleeves are not required for core-drilled holes.

D. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

   1. Cut sleeves to length for mounting flush with both surfaces.

      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

   2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
E. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

F. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION
   A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
   B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 ESCUTCHEONS
   A. Provide escutcheons where exposed piping passes through walls, floors, and ceilings in finished areas.

3.4 SLEEVES
   A. Floors: Sleeve all pipe penetrations. Extend sleeve 1-1/2" above finished floor, except piping within pipe chases. Sleeve shall be flush with underside of floor.
   B. Masonry or concrete walls: Sleeve all pipe penetrations. Sleeves shall be flush on both sides of wall.
   C. Drywall partitions: Sleeve all penetration of piping in systems over 160 degree F.
   D. Seal voids between outside surface of sleeve and wall, partition or floor. Seals shall be airtight.
   E. Install piping, insulation and sleeves in strict accordance with applicable U.L. floor or partition assembly instructions. Coordinate with Division 07 firestop manufacturer's installation instructions.
   F. Penetrations not sleeved or firestopped:
      1. Seal voids between pipe and partition. Seals shall be airtight.
3.5 ESCUTCHEON PLATES

A. Provide chromium plates escutcheon plates for exposed uninsulated pipes projecting through floors or walls in "finished" spaces. Mechanical rooms, store rooms, electric closets, and janitor closets are not considered "finished" spaces.

B. Clearance between sleeve and pipe: Minimum of 1/2 inch for hot piping and 1 inch for cold piping or as otherwise dictated by U.L. Fire Resistance Directory.

END OF SECTION 23 05 17
SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL (NOT USED)

PART 2 - PRODUCTS

2.1 HANGERS

A. Anvil Figure 260 clevis hangers with Figure 167, MSS Type 40 galvanized insulation protection shields (sized for supporting insulation having a compressive strength of 4 psi). Support piping on outside of insulation. Size hangers so that pipe insulation passes through them without interruption.
   1. Steam and condensate piping 3” diameter and less
   2. Hot water piping above 160 degrees F. 4” diameter and less.
   3. Chilled water piping.

B. Anvil Figure 171, MSS Type 41 with pipe roller, Anvil Figure 16x protection saddle and Anvil Figure 167, MSS Type 40 galvanized insulation protection shields (sized for supporting insulation having a compressive strength of 4 psi, at 8 foot intervals). Support piping on outside of insulation. Size hangers so that pipe insulation passes through them without interruption. Use these for:
   1. Steam and condensate piping 4” diameter and larger
   2. Hot water reheat above 160 degrees F. 6” diameter and larger

C. Anvil Figure CT-121, MSS Type 8, riser clamps (at floor penetrations) to support:
   1. Copper pipe risers

D. Anvil Figure 261, MSS Type 8, riser clamps (at floor slab penetrations) to support:
   1. Steel pipe risers

E. Anvil Powerstrut Trapeze Hangers: Where three or more lines of pipe run parallel, support them with trapeze hangers, sized for maximum 3/16” deflection.

2.2 INSERTS

A. Concrete Insert: Anvil Figure 281, MSS Type 18, universal concrete inserts, adequately sized and correctly positioned to support full load operating systems.

B. Concrete Insert, Wedge Type: Anvil Figure 281, 1/4" to 7/8”.

C. Lightweight Concrete Insert: Anvil Figure 285.

D. Continuous Concrete Insert: Anvil Powerstrut Figure PS-349 pre-galvanized.
2.3 EXPANSION ANCHORS
   A. Hilti Kwik-bolt, zinc plated, metal expansion anchor.
   B. Anchor to meet U.L., ICBO-4627 and FM listings.

2.4 CLAMPS
   A. C-Clamps: Anvil Figure 92, MSS Type 23.
      1. Use these for attaching hangers to steel beams. Do not weld hanger rods to structural steel members.
   B. Malleable Beam Clamps: Anvil Figure 218, MSS Type 30: Use these for attaching hangers to bar joists.

2.5 HANGERS RODS
   A. Provide mild steel, all-thread rods with maximum loads as follows:
      1. 3/8" - 300 lbs.
      2. 1/2" - 600 lbs.
      3. 5/8" - 1,200 lbs.
      4. 3/4" - 2,000 lbs.
      5. 1" - 5,000 lbs.

2.6 TRAPEZE PIPE HANGERS
   A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.7 THERMAL-HANGER SHIELD INSERTS
   A. Protect insulation at each hanger and support point with a 14 gauge galvanized shield which extends up to the centerline of the pipe and is centered inside the pipe hanger. Minimum shield length shall be 12". Provide a section of foam glass insulation between pipe and metal shield where glass fiberglass insulation is used on 3" and larger.

2.8 FASTENER SYSTEMS
   A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
2.9 EQUIPMENT SUPPORTS
   A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.10 UNISTRUT
   A. Provide floor mounted Unistrut for variable frequency drives and control panels as required.

2.11 ROOF CURBS
   A. Provide prefabricated metal roof curbs support of all roof-mounted equipment, fans and intake hoods. Construct curbs according to National Roof Contractor's Association guidelines. Prefabricated metal roof curbs shall be manufactured by ThyCurb, Custom Curb, or approved substitute.
   B. Construction curbs with minimum 18 gauge galvanized steel (14 gauge for curbs with any side longer than 4'-0" and for all curbs supporting equipment) with fully mitered and welded corners, integral base plate, internal reinforcing with 1" x 1" x 1/8" steel angle for curbs with any side longer than 3'-0", factory installed 1-1/2" thick, 3-pound density fiberglass insulation and factory installed pressure treated wood nailer. Minimum height of curb shall be 12" above finished roof surface. Consult architectural plans for roof type and thickness. Construct curbs to match slope of roof and provide a level top surface for mounting of mechanical equipment. Non-ducted equipment curbs shall be turned such that they are parallel to the slope of the roof (short side faces on-coming water).
   C. Curb types shall be as follows:
      1. Fan and intake hood penetration curbs with standard curb construction as described above - Thy Curb Model TC-3 with no cant.
      2. Equipment support curbs with minimum 18 gauge galvanized steel shell, base plate and counterflashing, wood nailer, and internal bulkhead reinforcement - ThyCurb Model TEMS.
   D. Install curbs in strict accordance with manufacturer's published installation instructions and as detailed on the drawings. Coordinate proper curb size, construction, and base prior to fabrication.

2.12 MISCELLANEOUS MATERIALS
   A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
   B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
      2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.


G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.
a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.
3.4 ADJUSTING
   A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
   B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING
   A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
      1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).
   B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified Division 09.
   C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE
   A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
   B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
   C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
   D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
   E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
   F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
   G. Use padded hangers for piping that is subject to scratching.
   H. Use thermal-hanger shield inserts for insulated piping and tubing.
   I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
      1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
      2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1-1/4 inches.
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 05 29
SECTION 23 05 33 - HEAT TRACING FOR EXTERIOR CHILLED WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install a complete U.L. listed system of heaters, components, and controls to prevent chilled water pipe lines from freezing.

1.2 WARRANTY

A. Provide three years warranty from date of Substantial Completion. Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 SELF-REGULATING HEATING CABLES

A. Comply with IEEE 515.1.

B. Heating Element: Pair of parallel No. 16 AWG, nickel-coated, copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating. The heater shall be equivalent to Raychem XL-Trace, Chromalox Rapid Trace or approved equal.

C. Electrical Insulating Jacket: Flame-retardant polyolefin.

D. Cable Cover: The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket.

E. Maximum Operating Temperature (Power On): 150 deg F.

F. Maximum Exposure Temperature (Power Off): 185 deg F.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Capacities and Characteristics:

<table>
<thead>
<tr>
<th>Diameter of Pipe</th>
<th>Watts/Foot of Pipe @ 40°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 inch or less</td>
<td>5</td>
</tr>
<tr>
<td>4 to 6</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>10 to 16</td>
<td>16</td>
</tr>
</tbody>
</table>
2.2 CONTROLS

A. The system shall be controlled by an ambient sensing thermostat set at 40 degrees F. either directly or through an appropriate contractor.

B. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.

C. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.

D. Corrosion-resistant, waterproof control enclosure.

2.3 ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

B. Warning Labels: Refer to Section 230553 "Identification for HVAC Piping and Equipment."

C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils (0.08 mm) thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install electric heating cable across expansion joints in strict accordance with manufacturer's written instructions; use slack cable to allow movement without damage to cable.

B. Install electric heating cables after piping has been tested and before insulation is installed.

C. Install electric heating cables according to IEEE 515.1.

D. Install insulation over piping with electric cables according to Section 230719 "HVAC Equipment and Piping Insulation."

E. Install warning tape on piping insulation where piping is equipped with electric heating cables.

F. Set field-adjustable switches and circuit-breaker trip ranges.

G. Ground fault equipment according to Section 427-22 of the National Electric Code.

H. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
   2. Test cables for electrical continuity and insulation integrity before energizing.
   3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.

C. Cables will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

E. Remove and replace damaged heat-tracing cables.

END OF SECTION 23 05 33
SECTION 23 05 48 - VIBRATION ISOLATION FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Isolate equipment as specified herein with factory-fabricated vibration isolators. Provide isolators of proper sizes and weight to meet the requirement.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Kinetics Noise Control or Mason Industries. Provide isolators by a single manufacturer.

2.2 FIBERGLASS OR NEOPRENE PADS

A. Provide Kinetics Model KIP

1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Pad Material: Oil and water resistant with elastomeric properties.
5. Infused nonwoven cotton or synthetic fibers.

B. Provide isolation pads for:

1. Chilled water pumps.
2. Hot water pumps.
3. Steam/Condensate pump.

2.3 SPRING AND RUBBER ISOLATION HANGERS

A. Provide Kinetics Model SFH or SRH for:

1. Suspended square in-line centrifugal fans (minimum 1.0" deflection).
2. Suspended unit heaters (minimum 1.0" deflection).
3. First three (3) piping hangers on each side of air handling units and pumps (minimum 1.5" deflection).
4. Suspended tubular centrifugal in line fans (minimum 2" deflection)
2.4 FLEXIBLE PIPE CONNECTORS

A. Provide Metraflex or approved substitute twin-sphere flexible rubber pipe connectors with female unions or floating flanges on piping connections to equipment subject to vibration.

B. Provide connectors rated for 150 PSI working pressure.

C. Provide flexible pipe connectors for the following:

1. Water connections to pumps.
2. Water connections to air handling units.
3. Water connections to air cooled chiller.

2.5 OUTDOOR APPLICATIONS

A. All isolators located outside exposed to weather shall be corrosion resistant construction with hot dip galvanizing or PVC coating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install vibration isolation in accordance with the isolator and equipment manufacturer's published installation instructions.

B. Size vibration isolation in accordance with weight distribution, pull or the imposed torque of actual equipment provided.

END OF SECTION 23 05 48
SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY (Not Applicable)

PART 2 - PRODUCTS

2.1 NAMEPLATES AND TAGS
   
   A. Acceptable manufacturers: Seton Nameplate Corporation or Marking Services Inc.
   
   B. Rigid plastic, "Setonite" or bakelite with engraved lettering, minimum 1/2" high.

2.2 PIPE MARKERS
   
   A. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering.

2.3 PIPE IDENTIFICATION
   
   A. Identify piping with Snap-on or Strap-on type markers as manufactured by Seton or approved substitute. Indicate contents of pipe and direction of flow on marker. Install markers on piping not more than 20 feet apart, at valves, access panels and above each space. Identify chilled water, hot water, steam (and pressure) and steam condensate return piping.
   
   B. Include design operating pressure in psig for steam.
   
   C. All piping in equipment rooms and concealed in accessible spaces (such as piping within lay-in ceiling space) shall be labeled to identify contents and direction of flow.

2.4 EQUIPMENT AND APPARATUS IDENTIFICATION
   
   A. Acceptable Manufacturers: Seton Name Plate Corporation or equal.
   
   B. Nameplates: Rigid plastic, "Setonite" or bakelite, with engraved lettering (indicating names and numbers of mechanical apparatus), a minimum of 1/2" high. Fill engraved lettering with a permanent coloring material which contrasts with color of tag material to allow for easy reading.
   
   C. Use names, numbers, and abbreviations appearing in schedules on Contract Drawings.
   
   D. Provide nameplates, located in a conspicuous location directly on the equipment or apparatus, for mechanical equipment including, but not limited to:
1. Chiller
2. Heat Exchanger
3. Air Handling Units
4. Variable Volume Terminals
5. Starters
6. Variable Frequency Drives
7. Pumps
8. Fans
9. Fan Coil Units
10. HVAC Equipment
11. Control Panels

E. Equipment Tags: Commercial quality, rust resisting nuts and bolts with backwashers, self-tapping screws, or rivets. Identification tags shall be constructed of engraving stock melamine plastic laminate, 1/8" minimum thickness, black and white core (letter color) punched for mechanical fastening. Letter height shall be minimum 1/2" tall.

F. Control Diagram Frames:

1. Seton Name Plate Corporation, No. 111P aluminum frames, or equal by Brady or Avery, with "plexiglass" or "lucite" glazing.
2. Provide control and systems instructions and diagrams, framed and glazed with specified items. Mount framed diagrams on walls in conspicuous, easily accessible places in each separate equipment room housing an A/C system to which the individual diagrams are applicable. The following instructions and diagrams are required:
   a. Control diagrams.
   b. Wiring diagrams.
   c. Sequence of operation, where applicable.
3. Diagrams and instructions may be reduced in size provided they are easily readable and lettering is not smaller than "10 pt." type.

PART 3 - EXECUTION (Not Applicable)
SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SERVICES

A. The balancing agency shall inspect the installation of the piping systems, sheet metal work, and the temperature controls. A minimum of two inspections shall be performed periodically as work progresses.

1. When 50 percent of the ductwork and piping is installed.
2. When 50 percent of the equipment is installed.

B. Perform test and balance in accordance with AABC or NEBB Standards.

C. The TAB Contractor shall work with the Control Contractor to assist in calibrating all airflow and water flow stations and duct and pipe mounted differential pressure sensors and duct mounted temperature sensors.

D. The Contractor shall provide Test and Balance Agency with copy of plans and specifications of Construction Documents. The Contractor shall correct prompt deficiencies of materials and workmanship identified as delaying the completion of the TAB work. The Contractor shall be responsible for any additional costs to the Owner resulting from his failure to have the HVAC systems and Building ready or from his failure to correct deficiencies promptly.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA’s "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine variable-air-volume boxes, and hot water coils. Verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures for balancing the systems.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:
   a. Duct systems are complete with terminals installed.
   b. Volume fire dampers are open and functional.
   c. Clean filters are installed.
   d. Fans are operating, free of vibration, and rotating in correct direction.
   e. Variable-frequency controllers’ startup is complete and safeties are verified.
   f. Automatic temperature-control systems are operational.
g. Ceilings are installed.
h. Windows and doors are installed.
i. Suitable access to balancing devices and equipment is provided.

2. Hydronics:
   a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
   b. Piping is complete with terminals installed.
   c. Water treatment is complete.
   d. Systems are flushed, filled, and air purged.
   e. Strainers are pulled and cleaned.
   f. Control valves are functioning per the sequence of operation.
   g. Shut-off and balance valves have been verified to be 100 percent open.
   h. Pumps are started and proper rotation is verified.
   i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
   j. Variable-frequency controllers' startup is complete and safeties are verified.
   k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233713 "Sheet Metal Specialties."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation" and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fanspeed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 and 233115.

3.5 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.

2. Verify that the system is under static pressure control.

3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:

a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.

b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.

c. When maximum airflow is correct, balance the air outlets downstream from terminal units.

d. Adjust controls so that terminal is calling for minimum airflow.

e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.

5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.

b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.

c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.

d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

6. Measure fan static pressures as follows:

   a. Measure static pressure directly at the fan outlet or through the flexible connection.
   b. Measure static pressure directly at the fan inlet or through the flexible connection.
   c. Measure static pressure across each component that makes up the air-handling system.
   d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

   a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
   b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.

9. Verify final system conditions as follows:

   a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
   b. Re-measure and confirm that total airflow is within design.
   c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
   d. Mark final settings.
   e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
   f. Verify tracking between supply and return fans.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems’ "as-built" piping layouts.
C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

3.7 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design gpm.

1. Measure total water flow.
   a. Position valves for full flow through coils.
   b. Measure flow by main flow meter, if installed.
   c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

2. Measure pump TDH as follows:
   a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
   b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
   c. Convert pressure to head and correct for differences in gage heights.
   d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
   e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.


B. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.
D. For systems with pressure-independent valves at terminals:
   1. Measure differential pressure and verify that it is within manufacturer's specified range.
   2. Perform temperature tests after flows have been verified.

E. Verify final system conditions as follows:
   1. Re-measure and confirm that total water flow is within design.
   2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
   3. Mark final settings.

F. Verify that memory stops have been set.

3.8 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:
   1. Verify that the differential-pressure sensor is located as indicated.
   2. Determine whether there is diversity in the system.

C. For systems with no diversity:
   1. Adjust pumps to deliver total design gpm.
      a. Measure total water flow.
         1) Position valves for full flow through coils.
         2) Measure flow by main flow meter, if installed.
         3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
      b. Measure pump TDH as follows:
         1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
         2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
         3) Convert pressure to head and correct for differences in gage heights.
         4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
         5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
2. Adjust flow-measuring devices installed in mains and branches to design water flows.
   a. Measure flow in main and branch pipes.
   b. Adjust main and branch balance valves for design flow.
   c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for each space to design water flows.
   a. Measure flow at terminals.
   b. Adjust each terminal to design flow.
   c. Re-measure each terminal after it is adjusted.
   d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
   e. Perform temperature tests after flows have been balanced.

4. For systems with pressure-independent valves at terminals:
   a. Measure differential pressure and verify that it is within manufacturer's specified range.
   b. Perform temperature tests after flows have been verified.

5. Prior to verifying final system conditions, determine the system differential-pressure set point.

6. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.

7. Mark final settings and verify that all memory stops have been set.

8. Verify final system conditions as follows:
   a. Re-measure and confirm that total water flow is within design.
   b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
   c. Mark final settings.

9. Verify that memory stops have been set.

D. For systems with diversity:

1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.
3. Adjust pumps to deliver total design gpm.
   a. Measure total water flow.
      1) Position valves for full flow through coils.
      2) Measure flow by main flow meter, if installed.
      3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
   b. Measure pump TDH as follows:
      1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gage heights.
4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.


4. Adjust flow-measuring devices installed in mains and branches to design water flows.
   a. Measure flow in main and branch pipes.
   b. Adjust main and branch balance valves for design flow.
   c. Re-measure each main and branch after all have been adjusted.

5. Adjust flow-measuring devices installed at terminals for each space to design water flows.
   a. Measure flow at terminals.
   b. Adjust each terminal to design flow.
   c. Re-measure each terminal after it is adjusted.
   d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
   e. Perform temperature tests after flows have been balanced.

6. For systems with pressure-independent valves at terminals:
   a. Measure differential pressure, and verify that it is within manufacturer's specified range.
   b. Perform temperature tests after flows have been verified.

7. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.

8. Prior to verifying final system conditions, determine system differential-pressure set point.

9. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.

10. Mark final settings and verify that memory stops have been set.

11. Verify final system conditions as follows:
   a. Re-measure and confirm that total water flow is within design.
   b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
   c. Mark final settings.

12. Verify that memory stops have been set.
3.9 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 5 percent.
3. Heating-Water Flow Rate: Plus or minus 5 percent.
4. Cooling-Water Flow Rate: Plus or minus 5 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.10 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
   a. Indicated versus final performance.
   b. Notable characteristics of systems.
   c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
   a. Settings for outdoor-, return-, and exhaust-air dampers.
   b. Conditions of filters.
   c. Cooling coil, wet- and dry-bulb conditions.
   d. Fan drive settings including settings and percentage of maximum pitch diameter.
   e. Settings for supply-air, static-pressure controller.
   f. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
   1. Quantities of outdoor, supply, return, and exhaust airflows.
   2. Water flow rates.
   3. Duct, outlet, and inlet sizes.
   4. Pipe and valve sizes and locations.
   5. Terminal units.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
   1. Unit Data:
      a. Unit identification.
      b. Location.
      c. Make and type.
      d. Model number and unit size.
      e. Manufacturer's serial number.
      f. Unit arrangement and class.
      g. Discharge arrangement.
      h. Sheave make, size in inches, and bore.
      i. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
      j. Number, make, and size of belts.
      k. Number, type, and size of filters.
   2. Motor Data:
      a. Motor make, and frame type and size.
      b. Horsepower and rpm.
      c. Volts, phase, and hertz.
      d. Full-load amperage and service factor.
      e. Sheave make, size in inches (mm), and bore.
      f. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
   3. Test Data (Indicated and Actual Values):
      a. Total airflow rate in cfm.
      b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. Outdoor airflow in cfm.
j. Return airflow in cfm.
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

F. Chiller test forms - Record the following items for each chiller:
   1. Manufacturer, model number, and serial number
   2. All design and manufacturer's rated data.
   3. Rated and actual pressure drop across evaporators and condensers and related GPM.
   4. Entering and leaving water temperatures for the evaporator and condenser.
   5. Rated and actual operating current and voltage.

G. Chiller:
   1. Record full load entering and leaving chilled water temperatures with glass stem, mercury
      thermometers accurate to 1/2 degree F.
   2. Record GPM at time of test.
   3. Record amperage and voltage.
   4. Perform log-test for a minimum of one hour taking readings at least every ten minutes.
   5. Average all readings and compute test capacity in BTU/HR. and in tons.
   6. Average all readings and compute actual kw/ton of chiller.

H. Heat-exchanger test forms - Record the following items on each heat exchanger test form:
   1. Manufacturer and model number.
   2. All design and manufacturer's rated data.
   3. Service and location.
   4. Actual pressure drop and related GPM or steam pressure, primary side.
   5. Actual pressure drop and related GPM, secondary side.
   6. Primary side entering and leaving temperatures.
   7. Secondary side entering and leaving temperatures.
   8. Temperature control setting.

I. Pump test forms - Submit pump curve showing design - operating - and no-flow points of operation. Also,
   record the following items on each pump test form:
   1. Manufacturer, size, and serial number.
   2. All design and manufacturer's rated data.
   3. Pump operating suction and discharge pressure and final total dynamic head.
   4. No flow (pump discharge valve closed) suction and discharge pressure and corresponding total
      dynamic head. This procedure is to determine actual impeller size.
   5. Rated and actual operating current, voltage, and brake horsepower of each pump motor as well as
      starter and heater data.
J. Apparatus-Coil Test Reports:

1. Coil Data:
   a. System identification.
   b. Location.
   c. Coil type.
   d. Number of rows.
   e. Fin spacing in fins per inch o.c.
   f. Make and model number.
   g. Face area in sq. ft.
   h. Tube size in NPS (DN).
   i. Tube and fin materials.
   j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
   a. Airflow rate in cfm.
   b. Average face velocity in fpm.
   c. Air pressure drop in inches wg.
   d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
   e. Return-air, wet- and dry-bulb temperatures in deg F.
   f. Entering-air, wet- and dry-bulb temperatures in deg F.
   g. Leaving-air, wet- and dry-bulb temperatures in deg F.
   h. Water flow rate in gpm (L/s).
   i. Water pressure differential in feet of head or psig.
   j. Entering-water temperature in deg F.
   k. Leaving-water temperature in deg F.

K. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and size.
   e. Manufacturer's serial number.
   f. Arrangement and class.
   g. Sheave make, size in inches, and bore.
   h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:
   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in \text{cfm}.
   b. Total system static pressure in \text{inches wg}.
   c. Fan rpm.
   d. Discharge static pressure in \text{inches wg}.
   e. Suction static pressure in \text{inches wg}.

L. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
   a. System and air-handling-unit number.
   b. Location and zone.
   c. Traverse air temperature in \text{deg F}.
   d. Duct static pressure in \text{inches wg}.
   e. Duct size in \text{inches}.
   f. Duct area in \text{sq. ft}.
   g. Indicated airflow rate in \text{cfm}.
   h. Indicated velocity in \text{fpm}.
   i. Actual airflow rate in \text{cfm}.
   j. Actual average velocity in \text{fpm}.
   k. Barometric pressure in \text{psig}.

M. Air-Terminal-Device Reports:

1. Unit Data:
   a. System and air-handling unit identification.
   b. Location and zone.
   c. Apparatus used for test.
   d. Area served.
   e. Make.
   f. Number from system diagram.
   g. Type and model number.
   h. Size.
   i. Effective area in \text{sq. ft}.

2. Test Data (Indicated and Actual Values):
   a. Airflow rate in \text{cfm}.
   b. Air velocity in \text{fpm}.
   c. Preliminary airflow rate as needed in \text{cfm}.
   d. Preliminary velocity as needed in \text{fpm}.
   e. Final airflow rate in \text{cfm}.
   f. Final velocity in \text{fpm}.
   g. Space temperature in \text{deg F}.
N. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:
   a. System and air-handling-unit identification.
   b. Location and zone.
   c. Room or riser served.
   d. Coil make and size.
   e. Flowmeter type.

2. Test Data (Indicated and Actual Values):
   a. Airflow rate in cfm.
   b. Entering-water temperature in deg F.
   c. Leaving-water temperature in deg F.
   d. Water pressure drop in feet of head or psig.
   e. Entering-air temperature in deg F.
   f. Leaving-air temperature in deg F.

O. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Service.
   d. Make and size.
   e. Model number and serial number.
   f. Water flow rate in gpm.
   g. Water pressure differential in feet of head or psig.
   h. Required net positive suction head in feet of head or psig.
   i. Pump rpm.
   j. Impeller diameter in inches.
   k. Motor make and frame size.
   l. Motor horsepower and rpm.
   m. Voltage at each connection.
   n. Amperage for each phase.
   o. Full-load amperage and service factor.
   p. Seal type.

2. Test Data (Indicated and Actual Values):
   a. Static head in feet of head or psig.
   b. Pump shutoff pressure in feet of head or psig.
   c. Actual impeller size in inches.
   d. Full-open flow rate in gpm.
   e. Full-open pressure in feet of head or psig.
   f. Final discharge pressure in feet of head or psig.
   g. Final suction pressure in feet of head or psig.
   h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.

j. Voltage at each connection.

k. Amperage for each phase.

P. Instrument Calibration Reports:

1. Report Data:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.

3.11 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect.

B. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:
   1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
   2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
   3. If the second verification also fails, Architect may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.12 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93
SECTION 23 07 13 - DUCT INSULATION

PART 1 - GENERAL

1.1 CERTIFICATION/QUALITY ASSURANCE


B. Fire-Test Response Characteristics: Testing in accordance with ASTM E-84. Insulation and related materials, adhesives, coatings, sealers, jackets and tapes, shall have a fire-test response characteristic of: Flame spread rating of 25 or less; Smoke development of 50 or less.

C. Materials shall meet the requirements of NFPA 90-A.

PART 2 - PRODUCTS

2.1 DUCTWORK INSULATION

A. Blanket Type Duct Insulation:
   1. Minimum 3/4 pound per cubic foot density, factory-reinforced foil-faced, kraft vapor barrier; with a minimum "R" value of 4.0.
   2. Acceptable manufacturers: Johns-Manville, or Owens Corning.
   3. Use on the following:
      a. Supply and Return - 2" thick.
      b. Reheat coils, including reheat coils at terminal boxes - 1-1/2" thick.
      c. Air flow stations.
      d. Top of supply air diffusers.

B. Board Type Duct Insulation:
   1. Provide minimum 3 pound per cubic foot density semi-rigid, factory-reinforced foil faced Kraft vapor barrier glass fiber board "system" type insulation; having a minimum "R" value of 4.34, unless otherwise specified.
   2. Acceptable manufacturers: Johns-Manville, or Owens Corning.
   3. Use on the following services:
      a. Supply and Return ductwork within Mechanical room - 1-1/2" thick.
      b. Ductwork supply outside air within Mechanical room - 1-1/2" thick
      c. Outside air intake plenums, return air plenums, ductwork and connections to mixing plenums in Mechanical room - 1-1/2" thick.
C. Duct Liner:
   1. Liner: Anti-microbial, 1" thick (unless otherwise indicated on drawings), UL listed, neoprene coated, mat faced, flexible fiberglass of three pounds per cubic foot density. Sizes shown on the drawings are free area dimensions, after installation of duct liner.
   2. Provide liner that complies with UL 181 Erosion Test and has a flame spread rating of 25 or less and a smoke developed rating of 50 or less.
      a. Plenums serving sidewall return and supply grilles.
      b. Plenums serving linear slot diffusers.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Deliver and store insulation materials in manufacturers containers and kept free from dirt, water, chemical and mechanical damage.

B. Complete ductwork pressure testing prior to applying insulation.

C. Apply insulation in workmanlike manner by experienced, qualified, workmen.

D. Surfaces shall be clean and dry when covering is applied. Covering to be dry when installed and before and during application of any finish, unless such finish requires specifically a wetted surface for application.

E. Adhesives, cements and mastics shall be compatible with materials applied and shall not attack materials in either wet or dry state.

F. Stop duct coverings, including jacket and insulation, at fire penetrations of fire or smoke rated partitions, floors above grade and roofs. "Fan-out" or extend jacketed insulation at least 2" beyond angle frames of fire dampers and secure to wall. Maintain vapor barrier.

3.2 BLANKET TYPE DUCT INSULATION

A. Apply jacketed blanket type glass fiber covering to ducts pulled snug but not so tight as to compress corners more than 1/4". Use insulation having 2" tab, or cut insulation long enough to allow for "peel-off" of insulation from jacket to effect a minimum overlap of 2". Staple lap with flare type staples on 1" centers. Cover standing seams, stiffeners, and braces with same insulation blanket, using 2" jacket lap and staple lap as herein before outlined. Cover and seal all staples with Foster 30-80 reinforced with glass cloth. Do not use pressure sensitive tape.

B. Secure jacket to covering using equivalent of Foster No. 85-20 or Childers CP-82 adhesive.

C. For ducts 24" or wider, mechanically fasten insulation to duct bottom, using weld pins having self-locking, metal discs, locating fasteners on not over 12" centers laterally and longitudinally. Seal pins as above.

D. For ducts up to 18" deep, mechanically fasten insulation to duct sides, using one row of pins, plates or discs located on not over 12" centers longitudinally and equidistant laterally between duct top and bottom. For ducts over 24" deep, apply fasteners as before only using minimum of two rows.
3.3 BOARD TYPE DUCT INSULATION

A. Apply jacketed board type glass fiber covering to ducts using weld pins having self-locking coated metal or nylon discs; locate fasteners on not over 12" centers laterally and longitudinally. If insulation is grooved to fit around corners, in order to eliminate as many joints as possible, pin as required to hold insulation tight to duct, especially on bottom of duct. Seal pins and joints with Foster 30-80 reinforced with glass cloth.

B. Cover all joints, rips, tears, punctures, disc heads, staples, or breaks in vapor barrier jacket with 4" wide woven glass fabric tape embedded in equivalent of Foster 30-80 vapor barrier, fire resistant adhesive. Do not use pressure sensitive tape.

3.4 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.5 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.6 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

   1. Comply with requirements in Division 07 "Penetration Firestopping" for firestopping and fire-resistant joint sealers.

C. Insulation Installation at Floor Penetrations:

   1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.

   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 "Penetration Firestopping."

END OF SECTION 23 07 13
SECTION 23 07 19 - HVAC EQUIPMENT AND PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following HVAC piping systems:
   1. Chilled-water piping, indoors and outdoors.
   2. Heating hot-water piping, indoors.
   3. Refrigerant suction and hot-gas piping, indoors and outdoors.

B. Section includes insulating the following HVAC equipment that is not factory insulated:
   1. Heat Exchanger
   2. Chilled Water Pump
   3. Chilled Water Bladder Tank
   4. Hot Water Heating Pump
   5. Expansion Tanks
   6. Air Separators
   7. Condensate Receiver Tank

1.2 SUBMITTALS

A. Submit manufacturer's product data and installation procedures for review.

PART 2 - PRODUCTS

2.1 PIPE AND EQUIPMENT INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Cellular Glass (Foamglass): Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Must have a minimum "R" value of 3.4 per inch at 75 degrees F mean temperature. Use Cellular Glass for the following:
   1. Exterior chilled water piping

C. Flexible Tubular Elastomeric:
   1. Provide fire-retardant closed-cell slip-on flexible type; minimum "R" value of 2.57
   2. Acceptable manufacturers: Armacell LLC or AP Armaflex
   3. Use on the following services:
      a. Moisture condensate drains - 1/2" thick
      b. Refrigerant suction and hot gas for split systems: 1" thick.
D. Flexible Sheet:

1. Provide closed-cell flexible sheet type; minimum "R" value of 3.57
2. Acceptable manufacturers: Armacell or AP Armaflex
3. Use on the following services:
   a. Air separators - 1-1/2" thick
   b. Refrigeration machine cooler, suction piping and pipe connections: 1-1/2" thick.

E. Custom made, field measured removable and reusable insulation cover.

1. Covers shall be as manufactured by Berry Soft Pack Fabricators or approved equal.
   a. Chilled water pump casings

F. Fiberglass Pipe Insulation:

2. Use on the following services:
   a. Chilled water piping - 2" and under: 1" thick; 2-1/2" and over: 1-1/2" thick
   b. Heating hot water piping, Runouts to terminal units (12 feet or less) 2" and less - 1/2" thick; 2-1/2" and greater - 1-1/2" thick.
   c. Steam condensate piping, 2" and under - 1-1/2" thick; 2-1/2" and greater - 2" thick
   d. Steam piping to 15 psi, 2" and under - 1-1/2" thick; 2-1/2" and greater - 2" thick
   e. Steam piping to 125 psi, 1" and under - 2-1/2" thick; 1-1/4" and greater - 3" thick
   f. Gravity condensate (steam) piping, 1-1/2" and under: 1-1/2" thick; 2" and greater: 2" thick.
   g. Pumped condensate (steam) piping: 1-1/2" and under: 1-1/2" thick; 2" and greater - 2" thick.
   h. Drain bodies, traps and horizontal drain lines receiving cold condensate - 1/2" thick
   i. Vents from condensate receiver tank and steam pressure reducing station relief valves: 1" thick.

G. Board-type glass fiber insulation:

1. Noncombustible semi-rigid, fiberglass board insulation, 3 pounds per cubic foot density; minimum "R" of 2.63.
2. Acceptable manufacturers: Johns-Manville and Owens Corning.
   a. Steam/Hot Water Exchanger - 2" thick
   b. Hot water air separators - 1" thick
   c. Condensate Receiver tanks - 2" thick
   d. Vents from pressure reducing station relief valve: 1" thick.
   e. Condensate pump receiver: 2" thick.
2.2 MATERIALS FOR FITTINGS, VALVES, AND SPECIAL COVERINGS

A. For all services, use premolded insulation for pipe fittings, elbows, tees, valves, and couplings matching basic insulation. Pre-molded insulation fittings shall be equal to those manufactured by Hamfab. Pre-molded insulation fitting shall be finished with glass fabric and vapor barrier mastic. Glass fiber blanket inserts with plastic cover are not acceptable for pipe fitting insulation. Field mitering is acceptable for fittings 8" and larger. Valves, strainers, flanges, etc. shall be covered with mitered insulation segments of the same type and thickness as adjoining pipe insulation.

B. For tanks, heat exchangers and large pipes in systems operating over 60 degrees F when exposed-to-view inside building or in equipment rooms, cover insulation with a smoothing coat of Keane Powerhouse cement, one layer of white colored woven glass fabric embedded and finished with Foster GPM mastic.

C. For pipe fittings, valves, strainers, and other irregular surfaces, in chilled water or refrigerant systems operating below 60 degrees F, when inside building or in equipment rooms, cover insulation with white colored woven glass fabric embedded in white vapor barrier coating, Foster 30-35 or equal.

D. All exposed interior mechanical piping and fittings shall be protected with a PVC jacket equal to Johns Manville Zeston 2000. Color selected by Architect.

E. For flexible tubular elastomeric pipe and fitting insulation when exposed-to-view inside building or exposed to the weather, finish with two coats of fire retardant self-extinguishing vinyl lacquer type highly flexible coating equivalent to Armstrong "Armaflex Finish", custom color blended to match surrounding surfaces.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Adhesives, cements and mastics shall be compatible with materials applied and shall not attack materials in either wet or dry state.

E. Install insulation with longitudinal seams at top and bottom of horizontal runs.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

H. Keep insulation materials dry during application and finishing.

I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

J. Install insulation with least number of joints practical.

K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

M. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

Q. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistant joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7 "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of cellular-glass insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed valve covers manufactured of same material as pipe insulation when available.
   2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:
   1. Aluminum, Smooth: 0.016 inch thick.

3.9 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed (at Chiller)
   1. Aluminum, Smooth: 0.016 inch thick.

3.10

A. Manual volume damper handles, airflow station pressure ports, access door handles, duct mounted instrumentation shall be left exposed or accessible above the insulation vapor barrier. Damper handles in externally wrapped ductwork shall be provided with stand-off brackets and locking quadrants to ensure the handle can be adjusted without disturbing the insulation vapor barrier.

END OF SECTION 23 07 19
SECTION 23 08 00 – MECHANICAL & CONTROLS SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification Section 01 91 13 – Commissioning

C. Specification Section 22 08 00 – Plumbing Systems Commissioning

D. Specification Section 23 08 13 – Sensor Point Calibration Check Sheet

E. Specification Section 23 0816 – Terminal Box Point Calibration Check Sheet

F. Specification Section 26 08 00 – Electrical & Lighting Systems Commissioning

G. Commissioning Plan (to be provided in Construction Phase containing process workflows, communication protocols, project-specific equipment checklists and project-specific functional performance test procedures)

1.2 COMMISSIONED SYSTEMS

A. The following systems, equipment and their components are included in the scope of the commissioning activities and are considered to be commissioned systems and equipment.

1. HVAC Power Ventilators

2. Air Terminal Units

3. Air Filters

4. Shell and Tube Heat Exchanger

5. Scroll Water Chillers

6. Modular Indoor Central-Station Air-Handling Units

7. Fan Coil Units

8. Blower Coil Units

9. Hydronic Pumps

10. Variable Frequency Motor Drives
11. Heat Tracing for Exterior Chilled Water Piping
12. Hydronic Piping Systems
13. Building Automation and Control System (BACS)

1.3 RESPONSIBILITIES

A. The Contractor shall be responsible for scheduling, supervising and performing start-up, testing and commissioning activities specified in this section and necessary to demonstrate to the Owner successful operation of the commissioned systems.

PART 2 - PRODUCTS

2.1 MEANS OF ACCESS

A. The Contractor shall provide means for the CxA to access, observe and visually confirm proper operation of all equipment and systems. These means shall be in compliance with all OSHA and job-site safety regulations.

2.2 TEST EQUIPMENT

A. The Contractor shall provide the necessary equipment to fully test the commissioned systems as defined in the functional performance test procedures to be provided by the CxA.

B. The test equipment shall meet the following minimum requirements.

1. All test equipment shall be in good mechanical and electrical condition.

2. Accuracy of metering in test equipment shall be appropriate for the test being performed.

C. Calibration

1. Calibration of all test equipment shall be current.

2. Calibration accuracy shall be traceable to National Institute of Standards and Technology (NIST).

3. Test equipment shall be calibrated in accordance with the following schedule.

   a. Field instruments
      1) Analog – At least every 6 months
      2) Digital – At least every 12 months

   b. Leased Specialty Equipment – At least every 12 months

4. Dated calibration labels shall be visible on all test equipment.

5. Calibration records shall be provided for all test equipment used in the project.
PART 3 EXECUTION

3.1 EQUIPMENT RECEIPT INSPECTION CHECKLISTS

A. Equipment receipt inspection checklists, provided by the CxA, shall be completed by the Contractor online using CxAloy TQ commissioning software. Free access to the software will be provided by the CxA to the Contractor’s personnel.

3.2 EQUIPMENT PRE-FUNCTIONAL CHECKLISTS

A. Equipment pre-functional checklists, provided by the CxA, shall be completed by the Contractor online using CxAloy TQ commissioning software. Free access to the software will be provided by the CxA to the Contractor’s personnel.

3.3 SENSOR POINT CALIBRATION CHECK SHEET

A. The Contractor shall check the accuracy of all points and recorded readings on the Sensor Point Calibration Check Sheet.

3.4 START-UP PLAN

A. The Contractor shall perform start-up testing for each piece of equipment to ensure that the equipment and systems are properly installed and ready for operation, so that functional performance testing may proceed without delays.

B. The Contractor shall prepare a start-up plan for each piece of equipment. This plan shall be submitted to the CxA for review and comment. The start-up plan shall consist, at a minimum of the following:

1. The manufacturer’s standard start-up and check out procedures copied from the installation manuals.

2. Checklists and procedures with specific spaces for recording and documenting the inspection of each procedure and a summary block for deficiencies and explanations.

C. Two (2) weeks prior to expected start-up for a piece of equipment, the Contractor shall notify the Owner and the CxA in writing. The execution of the start-up plan shall be directed and performed by the Contractor. The CxA and/or the Owner may be present for the start-up of the first unit of each type of equipment.

D. The Contractor shall submit the completed equipment checklists to the CxA for review. The Contractor shall note all non-compliance items on these checklists. The Contractor shall notify the CxA when outstanding items have been corrected.

E. The Contractor shall complete the start-up plan and resolve or correct all issues resolved before functional testing may begin.
3.5 FUNCTIONAL PERFORMANCE TESTS

A. The Contractor shall provide all documentation as requested to the CxA for development of functional performance testing procedures. This documentation shall include, at a minimum, manufacturer installation, start-up, operation and maintenance procedures. The CxA may request further documentation as necessary for the development of functional performance tests.

B. Functional performance tests shall be performed on all of the commissioned systems and equipment.

C. The Contractor shall review the functional performance test procedures developed by the CxA.

1. The Contractor shall respond in writing to the CxA regarding the acceptability of the proposed test procedures.

2. The Contractor shall note any necessary modifications to the procedures due to the actual equipment/systems or safety concerns and shall submit these to the CxA for consideration.

E. The Contractor shall place equipment and systems into operation and continue the operation as required during each working day of the testing activities.

F. The Contractor shall accomplish the functional performance testing of equipment based on procedures developed by the CxA and as reviewed by the Contractor.

1. The Contractor shall provide skilled technicians to operate the systems during functional performance testing. At a minimum, the contractor should provide one trade technician familiar with the system being tested and one controls technician to operate the system through the BAS.

2. The Contractor shall correct any deficiencies identified during testing and retest equipment as required.

G. Functional performance testing is intended to begin upon completion of a system. Functional performance testing may proceed prior to the completion of the system at the discretion of the CxA and the Contractor.

H. Functional testing shall verify all sequences of operation defined in the Contract Documents for the commissioned equipment and systems.

1. Testing shall occur by overriding setpoints or sensor readings at the BAS or by other means mutually agreed to by the Contractor, the CxA, and the Owner to initiate sequences of operation and verifying the response of the system.

2. Sequences of operation shall be verified under normal power, emergency power, and fire alarm scenarios.

I. Upon successful completion of all functional performance tests, the Contractor(s) shall perform Integrated Systems Testing. The testing shall document and verify the proper response of all Division 23 systems to all potential utility and emergency power operating and failure scenarios.

3.6 TEST AND BALANCE VERIFICATION

A. The Contractor shall provide the labor and test equipment necessary to demonstrate to the CxA that the HVAC air and water systems have been properly balanced.
B. The CxA will randomly select devices, equipment and systems for verification purposes.

1. The Contractor shall demonstrate validity of at least 20% of the air and 20% of the water balance values.

2. If more than 10% are found to be incorrect by +/- 10%, the Contractor shall demonstrate the validity of 50% of the balance report values.

3. If more than 10% of the additional readings are incorrect, then the Contractor shall check all the balance report values.

C. The Contractor shall regard this verification process as a functional performance test for purposes of time allowed to correct deficiencies and requirements regarding retesting if major problems are discovered.

D. The Contractor shall use the Terminal Box Point Calibration Check Sheet to record the readings that are verified. The Designer and Commissioning Authority may utilize the Test and Balance instruments furnished by the Test and Balance Contractor or provide their own instruments. All instruments utilized must have been calibrated within the past 12 months.

END OF SECTION 23 08 00
# Sensor Point Calibration Check Sheet

Owner's Project Number: 166/

Institution or Campus: 

Building: 

Installer: 

**System/Unit Identifier:** 

**Location:** 

---

List all sensors associated with this system or unit and verify the calibration, set point and location.

<table>
<thead>
<tr>
<th>Sensor Description</th>
<th>Location Satisfactory (Y/N)</th>
<th>BAS Reading</th>
<th>Field Measurement Value</th>
<th>Action Required</th>
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**NOTES:**

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**Page 1 of 1**

*Posted in XLS format June 2011 OFD s230813*
### TERMINAL BOX POINT CALIBRATION CHECK SHEET

**Owner's Project Number:** 166/  
**System/Unit Identifier:**  
**Location:**  

List all terminal boxes associated with this system or unit and verify thermostat calibration and sequence of reheat coil hot water control valve and terminal box response to thermostat command.

<table>
<thead>
<tr>
<th>Terminal Box #</th>
<th>Design Airflow (cfm)</th>
<th>BAS / Thermostat / Airflow Data</th>
<th>BAS DAT sensor Value F</th>
<th>HW Valve Response Value F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MIN</td>
<td>MAX</td>
<td>Set Point F</td>
<td>cfm</td>
</tr>
</tbody>
</table>

**List all terminal boxes associated with this system or unit and verify thermostat calibration and sequence of reheat coil hot water control valve and terminal box response to thermostat command.**
SECTION 23 09 23 - DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Direct Digital Control/Building Automation System (DDC/BAS) shall be an extension to the existing campus system, which is Johnson Controls Metasys.

B. Provide a complete control system including electrical interlocks, wiring, conduit, relays, switches, control transformers, and all devices required for a complete operational system.

C. The Control Contractor shall work in close cooperation with the TAB agency in calibrating all airflow and water flow stations and all duct and pipe mounted differential pressure sensor/transmitters.

1.2 SUBMITTALS

A. Product Data: For each type of product include the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.

2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.


4. Installation, operation and maintenance instructions including factors effecting performance.

5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.

6. When manufacturer’s product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.

7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

8. Schematic drawings for each controlled HVAC system indicating the following:

   a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.

   b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.

   c. A graphic showing location of control I/O in proper relationship to HVAC system.

   d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.

   e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
g. Narrative sequence of operation.
h. Graphic sequence of operation, showing all inputs and output logical blocks.

B. System Description:
   1. Full description of the existing DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
   2. Complete listing and description of each report, log and trend available for format and timing and events which initiate generation.
   3. Design Submittal Schedule and design calculations for control valves and actuators.
      a. Flow at Project design and minimum flow conditions.
      b. Pressure-differential drop across valve at Project design flow condition.
      c. Maximum system pressure-differential drop (pump close-off pressure) across valve at Project minimum flow condition.
      d. Design and minimum control valve coefficient with corresponding valve position.
      e. Maximum close-off pressure.
      f. Leakage flow at maximum system pressure differential.
      g. Torque required at worst case condition for sizing actuator.
      h. Actuator selection indicating torque provided.
      i. Actuator signal to control damper (on, close or modulate).
      j. Actuator position on loss of power.
      k. Actuator position on loss of control signal.

C. Product Certificates:
   1. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For DDC system to include operation and maintenance manuals.
   a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
   b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
   c. As-built versions of submittal Product Data.
   d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
   e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
   f. Backup copy of graphic files, programs, and database on electronic media such as DVDs.
   g. List of recommended spare parts with part numbers and suppliers.
   h. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
i. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.

j. Licenses, guarantees, and warranty documents.

k. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

l. Owner training materials.

1.4 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified 12 month warranty period.

   1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.

   2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.

      a. Install updates only after receiving Owner's written authorization.

   3. Warranty service shall occur during normal business hours and commence within 24 hours of Owner's warranty service request.

   4. Warranty Period: One year from date of Substantial Completion.

   5. Replacing defective parts and components as required.

PART 2 - PRODUCTS

2.1 DDC SYSTEM DESCRIPTION

A. Direct Digital Control/Building Automation Systems (DDC/BAS) shall be fully compatible with ETSU College of Medicine Campus Standard automation system and shall be Johnson Controls Metasys.

B. Web based, building automation system (BAS) incorporating direct digital control (DDC), energy management, and equipment monitoring and control.

2.2 STAND-ALONG DDC PANELS

A. General: Stand-alone DDC panels shall be microprocessor based, multi-tasking, multi-user, real-time digital control processors. Each stand-alone DDC panel shall consist of modular hardware with plug-in enclosed processors, communication controllers, power supplies, and input/output modules. Each DDC panel shall operate independently be performing its own specified control, alarm management operator I/O and historical data collection.

B. Memory: Each DDC panel shall have sufficient memory to support its own operating system and databases.

C. Point Types: Each DDC panel shall support the following types of point inputs and outputs:

   1. Digital Inputs for status/alarm contacts
2. Digital Outputs for on/off equipment control
3. Analog Inputs for temperature, pressure, humidity, flow, and position measurements
4. Analog Outputs for valve and damper position control, and capacity control of primary equipment
5. Pulse Inputs for pulsed contact monitoring

D. Integrated On-Line Diagnostics: Each DDC panel shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all subsidiary equipment.

E. Surge and Transient Protection: Isolation shall be provided at all network terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE Standard 587-1980. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.

F. Powerfail Restart: In the event of the loss of normal power, there shall be an orderly shutdown of all stand-alone DDC panels to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery back-up shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours. Upon restoration of normal power, the DDC panel shall automatically resume full operation without manual intervention.

2.3 SENSORS

A. BAS Sensors:

1. Provide sensors, controls, instruments, and control interfaces to meet the performance specified herein. Sensors shall be high quality precision electronic type, selected to be compatible with the BAS controllers and appropriate for the service specified herein. Accuracy values specified herein include sensor, wiring, signal conditioning and display accuracies for overall end-to-end performance. Sensors shall be selected to place the expected value in the middle third of the device's range.

2. Temperature sensors: 100 or 1000 ohm nickel resistance temperature device (RTD), Deutsche Industrial Norms (DIN) 43760, with an average percent change in resistance per degree (α) of 0.00385± 0.00002 ohms/ohm/°C, selected for normal range of media sensed with accuracy of ±0.5°F at 70°F except chilled water sensors used for Btu calculations shall have an accuracy of ±0.25°F at 32°F. Sensors used for Btu calculations shall be matched pairs at the calibration point. Temperature sensor stability errors shall not exceed 0.25°F cumulative over a 5 year period. Provide thermowells and insertion type sensors for water temperature sensing. Air temperature sensing shall be provided by duct insertion type sensors for supply or return duct temperatures and by extended element averaging type for plenum, and coil entering or leaving temperatures. RTD transmitters shall be a 2-wire, loop-powered device, producing a linear 4-20 mA output corresponding to the temperature span of the connected sensor. The output error shall not exceed 0.1% of calibrated span. Transmitters shall include noninteracting offset and span adjustments and RFI shielding and rejection circuitry to prevent disruption from ambient signals. Transmitter drift shall be less than 0.1°F per year.

3. Space temperature sensors: space temperature type with setpoint adjustment range of 45°F to 85°F. The setpoint adjustment shall be locked out, overridden, or limited as to time or temperature in software from a central or remote operator's terminal. Precision thermistors may be used in space temperature sensing applications below 200°F. Sensor accuracy over the application range
shall be minimum 0.5°F between the range of 32°F to 150°F including sensor error and A/D conversion resolution error. Sensor manufacturer shall utilize 100% screening to verify accuracy. Thermistors shall be pre-aged and inherently stable. Stability error of the thermistor over 5 years shall not exceed 0.25°F cumulative. Sensor element and leads shall be encapsulated. Bead thermistors shall not be used. Space temperature sensors shall include a communications port for local connection of a portable test/terminal device for communications/programming access to the associated BCS controller.

a. Covers:
   1) Space temperature sensors shall have cover, visible temperature indicator integral to the sensor, and accessible means of setpoint adjustment.

4. Humidity sensors: bulk polymer type, with self-contained 4-20 mA transmitter and replaceable element. Accuracy shall be ±2% RH in the range of 20% to 90%. the transmitter shall include noninteracting zero and span adjustments with an output error not exceeding 0.1% of calibrated span. Saturation shall not alter calibration. Sensors for space humidity shall have same appearance as space temperature sensors.

5. Pressure transmitters: 2-wire strain gauge type, designed for media sensed for static pressure or differential pressure. The span shall be continuously adjustable from 0% to 125% of the expected full pressure of full flow differential pressure. The zero shall be continuously adjustable on outputs. Transmitters shall produce a 4-20 mA signal with an accuracy of ±1.0% of the upper range limit for 6 months from calibration. Instruments shall be capable of withstanding an overrange pressure limit of 300 normal.

6. Current sensing relays: current sensing relays shall provide an adjustable setpoint normally open contact rated at a minimum of 50 V peak and 0.5 A or 25 VA, noninductive. There shall be a single opening for passage of current carrying conductors. Relays shall be sized for operation at 50% rated current based on the connected load. Voltage isolation shall be a minimum of 600 V.

7. Filter status: filter status shall be sensed by digital pressure differential switches.

8. CO\textsubscript{2} sensors: dual channel infrared type, with 10 micron filter to prevent particulate contamination of sensing element. Sensor shall have an accuracy of ±5% of reading up to 10000 ppm, with a repeatability of ±20 ppm and a maximum drift of ±10 ppm per year, and a recommended calibration interval of 5 years. Sensor shall have a response time of no more than 2 minutes to a 90% of full scale change. Sensor and transmitter shall provide a 4-20 mA analog output proportional to gas concentration.

2.4 MATERIALS

A. Actuators:

1. BAS terminal unit actuators: 24 V nonstall type, providing complete modulating control for the full range of damper movement. Actuators shall be de-energized when the damper has reached the operator or system determined position. Actuators shall be supplied to the terminal unit manufacturer for factory mounting and calibration. Actuators shall be removable for servicing without removing the terminal unit. Actuators shall be provided with transformers for proper operation from the terminal unit controller power source.

2. Other actuators: 24 V electric worm-gear type; sized to provide required starting torque and to control the drive apparatus smoothly. Higher voltage actuators are acceptable for specific applications where 24 V actuators are not adequate. Actuators shall have spring return.
B. Control valves: 2" and smaller, globe ball type with bronze bodies and screwed connections; over 2", globe type with cast iron bodies and flanged connections.

1. Valves shall be capable of full closure against 150% of design pump head, or a 50 psig differential pressure, whichever is greater.
2. Valves for water shall have equal percentage flow characteristics. Modulating control valves shall be sized for a pressure drop of 3 psig to 5 psig, unless indicated otherwise on the Drawings. Two-position valves shall be in line size.
3. Valves for steam shall have linear flow characteristics. Steam valve sizes are indicated on the Drawings.
4. Pressure/temperature rating: as specified in Section 23 10 00, "Piping, Valves and Accessories".
5. At the Contractor's option, control valves may be butterfly type for chilled and condenser water service in piping 8" and larger. Modulating butterfly valves shall be sized for full flow pressure drop of 2 psig to 4 psig at 60% open and be limited to this opening. Two-position butterfly valves shall be line size. Valves shall be rated for bubble tight closure at a differential pressure equal to the valve body rating.

C. Control dampers: single-blade up to 8" high, multiblade over 8" high; minimum 80% free area based on damper frame outside dimensions.

1. Blades: minimum 16 gauge galvanized steel, or extruded aluminum. Blades shall be airfoil shape.
   a. Pivot rods: steel, minimum 0.5" diameter or hex, with one rod extended 6" to permit operation of damper from outside the duct.
   b. Maximum length 42", maximum width 8".
   c. At points of contact: interlocking or overlapping edges, and compressible neoprene or extruded vinyl blade seals, and compressible metal side seals designed for temperature -40°F to 180°F at leakage rate specified herein.
   d. Type:
      1) Opposed blade: for balancing and modulating applications.
      2) Parallel blade: for 2-position, and outside and return air mixing applications. For mixing applications, orient dampers to achieve maximum mixing at throttled conditions.
   e. Maximum damper area per motor: 15ft².

2. Leakage when closed: less than 4 cfm/ft² at 1" wg differential static pressure based on a 48" damper width.

3. Frames: galvanized steel bar minimum 2" wide x 12 gauge for dampers 10" high or less, and 3.5" x 0.875", 16 gauge galvanized roll-formed channel with double-thickness edges or 5" x 1" x 0.125" extruded aluminum channel for 11" high and larger.
   a. Corner bracing.
   b. Full size of duct or opening in which installed.

   a. Thrust bearings: vertically mounted.
b. Maximum spacing: 42”.

5. Finish on steel parts: galvanized.
6. Operating linkage: factory-assembled, concealed in frame out of airstream, steel construction.

D. Panels: Surface type cabinet with hinged front panel and cylinder lock. Panels shall utilize one master key.

E. Thermowells: monel, brass, or copper for use in water piping and stainless steel for other applications. Thermowells shall have threaded plug and chain, retaining nut, and lagging neck to clear insulation. Inside diameter of insertion neck shall accommodate the element being installed.

F. Weather shield enclosures: NEMA 3R rated with transparent cover, sized for the device enclosed.

G. Airflow measurement systems: provide complete UL listed assemblies to monitor airflow in ductwork at locations indicated on the Drawings. Each system shall be complete with one or more multipoint measuring probes, airflow sensors and a single microprocessor-based transmitter.

1. Probes: Aluminum or stainless steel construction with mounting brackets. Probes shall be supported at both ends.
2. Airflow sensors: Designed to operate at velocities of 50 fpm to 5000 fpm, temperatures of -20°F to 140°F, and relative humidities of 0% to 99% (noncondensing). Each sensing point shall independently determine the airflow rate which shall be equally weighted and averaged by the transmitter prior to output.
3. The minimum number of sensors for each assembly shall be as follows:

<table>
<thead>
<tr>
<th>Area, (ft²)</th>
<th>No. of Sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 4</td>
<td>4</td>
</tr>
<tr>
<td>4 to 8</td>
<td>6</td>
</tr>
<tr>
<td>8 to 12</td>
<td>8</td>
</tr>
<tr>
<td>12 to 16</td>
<td>12</td>
</tr>
<tr>
<td>&gt; 16</td>
<td>16</td>
</tr>
</tbody>
</table>

4. Transmitters: Designed to operate at temperatures of -20°F to 120°F and provided with LCD display 24 V AC power connection, and analog output signal (0-10 V DC or 4-20 mA) for connection to the BCS.
5. Accuracy: ±2% of reading over the entire operating airflow range.

2.5 ELECTRONIC AND ELECTRIC CONTROL COMPONENTS

A. Electric Thermostats: Thermostats to be manufacturer’s best commercial grade thermostat with adjustable setpoint, dials calibrated in degrees F. Select thermostats with suitable range for service intended. Provide each thermostat with locking metal cover. Thermostat shall be equal to Johnson Controls TE-67NP-2N00.

B. Electronic Sensors/Transmitters: Sensors/transmitters to be 1000 Ohm platinum RTD type with high resistance change vs. temperature or humidity change, accurate to ± 0.3 degrees F for temperature and ± 2.0% for humidity at applicable range, and provide 4 to 20 MA or 0 to 5 VDC output signal. Sensors/transmitters to be suitable for room, duct, or well mounting as required by application. Room type
to have built-in setpoint potentiometer and digital room temperature/humidity indication. Select for temperature/humidity range of application. Provide appropriate mounting plate and hardware. Temperature sensors used as a part of Energy (BTU) Measurement System shall meet the applicable requirements of that section.

C. Freezestats (Low Limit Binary Type): Provide single, custom length Freon-filled capillary tube type with sensing element actuated by temperature on any one foot portion. Sensor shall be a single element with length of one linear foot for every one square foot of coil face area. Freezestats to be UL approved, manual reset type.

D. Control Panels: Control panels to be constructed of unitized steel or aluminum cabinets. Provide cabinets with hinged, locking door opening to the front. Multiple panels mounted side-by-side to be hinged to the left or on opposite sides to open in the middle. Start-stop switches, hand-off-automatic switches, pilot lights, and temperature indicating devices to be flush-mounted in panel door. All other devices to be internally mounted within panel. Local panels exposed to weather to be weatherproof construction. Panel locations to be approved by Designer and be accessible for operation and maintenance. All lines in panel shall have number I.D. bands. All devices inside the panel or mounted on panel face shall have an engraved laminated plastic nameplate. Wiring within panel to conform to National Electrical Code, and shall be neatly bundled and laced or enclosed in conduit.

E. Transformers: Provide all 24-volt control transformers necessary to convert 120-volt line voltage power to control voltage at control devices.

F. Relays, Hand-Off-Auto Switches, Pilot Lights: Provide all relays, hand-off-auto switches, and pilot lights necessary to accomplish automatic control of the mechanical systems. See electrical drawings for starters provided integral with hand-off-autos, pilot lights, and auxiliary contacts.

G. Pressure Switches: Pressure switches shall have contact action and pole configuration as required by application, U.L. listing, and adjustable setpoint.

2.6 AIR FLOW MEASURING STATION

A. Multi-point electronic thermistor probe suitable for duct or fan inlet airflow measurement with transmitter, equal to Ebtron Gold Series. Provide aluminum alloy casing, ± 2% / ± .25% accuracy/repeatability and UL listed transmitter.

2.7 PRESSURE TRANSMITTERS/TRANSDUCERS:

A. Acceptable Manufacturers:

1. MAMAC Systems, Inc.

B. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.

1. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
2. Output: 4 to 20 mA.
3. Building Static-Pressure Range: 0- to 0.25-inch wg.
4. Duct Static-Pressure Range: 0- to 5-inch wg.

C. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.

D. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and testing to 300-psig; linear output 4 to 20 mA.

E. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.

F. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

2.8 APPLICATION SPECIFIC CONTROLLERS - HVAC APPLICATIONS

A. Each stand-alone DDC controller shall be able to extend its performance and capacity through the use of remote Application Specific Controllers (ASCs).

B. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor.

C. Each ASC shall have sufficient memory to support its own operating system and data bases.

D. The operator interface to any ASC point data or programs shall be through any network-resident PC workstation or portable operator’s terminal connected to any DDC panel in the network.

E. Application specific controllers shall directly support the temporary use of a portable service terminal.

F. Powerfail Protection: All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the controller.

G. The modes of operation supported by each ASC shall minimally include, but not be limited to, the following:
   1. Daily/Weekly Schedules
   2. Occupancy Mode
   3. Economy Mode.
   4. Temporary override Mode

H. Continuous Zone Temperature Histories: Each ASC shall automatically and continuously maintain a history of the associated zone temperature to allow users to quickly analyze space comfort and equipment performance for the past 24 hours. A minimum of two samples per hour shall be stored.

I. Alarm Management: Each ASC shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.

J. Application Descriptions:
1. VAV Terminal Unit Controllers:
   a. VAV terminal unit controllers shall support, but not be limited to, the control of the following configurations of VAV boxes to address current requirements as described in the Execution portion of this specification, and for future expansion.
      1) Single Duct (Cooling Only or Cooling With Reheat)
   b. VAV terminal unit controllers shall support the following types of point inputs and outputs:
      1) Proportional Cooling Outputs
      2) Heating Outputs
   c. Each VAV terminal unit shall be provided with a thermostat with numerical temperature setpoint adjustment with scales graduated in degrees F.

2. AHU Controllers:
   a. AHU controllers shall support all the necessary point inputs and outputs to perform the specified control sequences in a totally stand-alone fashion.
   b. AHU controllers shall have a library of control routines and program logic to perform the sequence of operation.

2.9 DDC CONTROLLERS

A. Expansion to the existing DDC system shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.

B. DDC controllers shall perform monitoring, control, energy optimization and other requirements indicated.

C. DDC controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.

D. Each DDC controller shall be capable of full and complete operation as a completely independent unit and as a part of a DDC system wide distributed network.

E. Environment Requirements:
   1. Controller hardware shall be suitable for the anticipated ambient conditions.

F. Power and Noise Immunity:
   1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
   2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios with up to 5 W of power located within 36 inches of enclosure.

G. DDC Controller Spare Processing Capacity:
1. Include spare processing memory for each controller. RAM, PROM, or EEPROM will implement requirements indicated with the following spare memory:
   
a. Network Controllers: 50 percent.
b. Programmable Application Controllers: Not less than 60 percent.
c. Application-Specific Controllers: Not less than 80 percent.

2. Memory shall support DDC controller's operating system and database and shall include the following:
   
a. Monitoring and control.
b. Energy management, operation and optimization applications.
c. Alarm management.
d. Historical trend data of all connected I/O points.
e. Maintenance applications.
f. Operator interfaces.
g. Monitoring of manual overrides.

H. Input and Output Point Interface:
   
1. Hardwired input and output points shall connect to network, programmable application and application-specific controllers. 
2. Input and output points shall be protected so shorting of point to itself, to another point, or to ground will not damage controller. 
3. Input and output points shall be protected from voltage up to 24 V of any duration so that contact will not damage controller.

2.10 PROGRAMMABLE APPLICATION CONTROLLERS

A. General Programmable Application Controller Requirements:
   
1. Include adequate number of controllers to achieve performance indicated.
2. Controller shall have enough memory to support its operating system, database, and programming requirements.
3. Data shall be shared between networked controllers and other network devices.
4. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
5. Controllers that perform scheduling shall have a real-time clock.
6. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification. 
7. Controllers shall be fully programmable.

B. Communication:

1. Programmable application controllers shall communicate with other devices on network.

C. Operator Interface:
1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.11 ELECTRICAL POWER DEVICES

A. Transformers:

1. Transformer shall be sized for the total connected load, plus an additional 25 percent of connected load.
2. Transformer shall be at least 40 VA.
3. Transformer shall have both primary and secondary fuses.

B. DC Power Supply:

1. Plug-in style suitable for mating with a standard eight-pin octal socket. Include the power supply with a mating mounting socket.
2. Enclose circuitry in a housing.
3. Include both line and load regulation to ensure a stable output. To protect both the power supply and the load, power supply shall have an automatic current limiting circuit.
4. Performance:
   a. Output voltage nominally 25-V dc within 5 percent.
   b. Output current up to 100 mA.
   c. Input voltage nominally 120-V ac, 60 Hz.
   d. Load regulation within 0.5 percent from zero- to 100-mA load.
   e. Line regulation within 0.5 percent at a 100-mA load for a 10 percent line change.
   f. Stability within 0.1 percent of rated volts for 24 hours after a 20-minute warmup.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install products to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Support products, tubing, piping wiring and raceways. Brace products to prevent lateral movement and sway or a break in attachment when subjected to a force.
D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.

E. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

F. Firestop penetrations made in fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

G. Seal penetrations made in acoustically rated assemblies. Comply with requirements in Section 079200 "Joint Sealants."

H. Fastening Hardware:
   1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
   3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.

I. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, cabinets, building wire and cable according to Division 26.
   1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
   2. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
   3. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
   4. Number-code and color-code conductors for future identification and service of control system, except local individual room control cables.
   5. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

3.3 FINAL REVIEW

A. Submit written request to Architect and Construction Manager when DDC system is ready for final review. Written request shall state the following:
   1. DDC system has been thoroughly inspected for compliance with contract documents and found to be in full compliance.
   2. DDC system has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
3. DDC system monitoring and control of HVAC systems results in operation according to sequences of operation indicated.

4. DDC system is complete and ready for final review.

B. Review by Architect and Construction Manager shall be made after receipt of written request. A field report shall be issued to document observations and deficiencies.

C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.

D. Prepare and submit closeout submittals when no deficiencies are reported.

E. A part of DDC system final review shall include a demonstration to parties participating in final review.

   1. Provide staff familiar with DDC system installed to demonstrate operation of DDC system during final review.
   2. Provide testing equipment to demonstrate accuracy and other performance requirements of DDC system that is requested by reviewers during final review.
   3. Demonstration shall include, but not be limited to, the following:

   a. Accuracy and calibration of 20 I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.

   b. HVAC equipment and system hardwired and software safeties and life-safety functions are operating according to sequence of operation. Up to 20 I/O points shall be randomly selected by reviewers. Additional I/O points may be selected by reviewers to discover problems with operation.

   c. Correct sequence of operation after electrical power interruption and resumption after electrical power is restored for randomly selected HVAC systems.

   d. Operation of randomly selected dampers and valves in normal-on, normal-off and failed positions.

   e. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and operator workstations.

   f. Trends, summaries, logs and reports set-up for Project.

   g. For up to three HVAC systems randomly selected by reviewers, use graph trends to show that sequence of operation is executed in correct manner and that HVAC systems operate properly through complete sequence of operation including different modes of operations indicated. Show that control loops are stable and operating at set points and respond to changes in set point of 20 percent or more.

   h. Software's ability to communicate with controllers, operator workstations, uploading and downloading of control programs.

   i. Software's ability to edit control programs off-line.

   j. Data entry to show Project-specific customizing capability including parameter changes.

   k. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.

   l. Execution of digital and analog commands in graphic mode.

   m. Spreadsheet and curve plot software and its integration with database.

   n. Online user guide and help functions.
o. Multitasking by showing different operations occurring simultaneously on four quadrants of split screen.
p. System speed of response compared to requirements indicated.
q. For Each Programmable Application Controller:
   1) Memory: Programmed data, parameters, trend and alarm history collected during normal operation is not lost during power failure.
   2) Operator Interface: Ability to connect directly to each type of digital controller with a portable operator workstation and PDA. Show that maintenance personnel interface tools perform as indicated in manufacturer’s technical literature.
   3) Standalone Ability: Demonstrate that controllers provide stable and reliable standalone operation using default values or other method for values normally read over network.
   4) Electric Power: Ability to disconnect any controller safely from its power source.
   5) Wiring Labels: Match control drawings.
   6) Network Communication: Ability to locate a controller’s location on network and communication architecture matches Shop Drawings.
   7) Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators and devices.
r. For Existing Operator Workstation:
   1) I/O points lists agree with naming conventions.
   2) Graphics are complete.
   3) UPS unit, if applicable, operates.

3.4 ADJUSTING
A. Occupancy Adjustments: When requested within 12 [Insert number] months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two [Insert number] visits to Project during other-than-normal occupancy hours for this purpose.

3.5 DEMONSTRATION
A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner’s maintenance personnel to adjust, operate, and maintain DDC system.
B. Extent of Training:
   1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
   2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
   3. Minimum Training Requirements: Provide not less than one day of training.
C. Training Schedule:
1. Training shall occur within normal business hours at a mutually agreed on time.

D. Attendee Training Manuals:

1. Provide each attendee with a color hard copy of all training materials and visual presentations.
2. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.

END OF SECTION 23 09 23
SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 GENERAL

A. Submit pipe and fitting. Work shall not start until approval. Pipe, fittings, weights, working pressure and classification shall be clearly marked.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Hard-Drawn Seamless Copper Tubing: ASTM B 88, Type L (ASTM B 88M). Elbows are to be long radius pattern. Solder shall be 95-5 type. “Tee pullers” shall not be used in place of tees on copper piping.

1. Heating hot water supply and return piping 2” and smaller.
2. Chilled water supply and return piping 2” and smaller.

B. Copper Pipe Fittings: ASTM B-62, dimensions conforming to ANSI B16.22, wrought copper, with sweep patterns for copper tubing. Provide dielectric couplers at junction of steel pipe and copper piping systems.

C. DWV Copper Tubing: ASTM B 306, Type DWV for above ground moisture condensate drain piping.

D. Unions to be brass ground joint, 250-pound working pressure.

E. Nipples used in conjunction with copper pipe to be brass.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A-53, black steel, Schedule 40 with welded and seamless, Grade B, and wall thickness as indicated in “Piping Applications” Article.

1. Heating hot water supply and return piping 2-1/2” and larger.
2. Chilled water supply and return piping 2-1/2” and larger.

B. Piping 2-1/2” and larger shall be seamless black steel, Schedule 40, ASTM A-53, Gr. B, or A106 with welded or flanged fittings, ANSI B16.9. ERW piping may be considered. Elbows are to be long radius pattern. Field-fabricated fittings are not acceptable. Forged steel, gasketed flanges, ANSI B16.5, of the welded neck type are to be used at flanged connections. Slip-on type may be used on straight pipe. Flanges must be compatible with valve and equipment connections. Where a branch connection from a main or header is one half the main diameter or smaller, saddle-type, forged steel welding fittings may be used.
C. Welding shall conform to ANSI Code for Pressure Piping, Section B31.1. All welds shall be of the single "V" butt joint type with optimum fusions and 100% weld penetration of wall thickness. Piping should be welded by the shielded arc type electrode-electric arc process. Butt joints should be made with split backing rings. In most cases, direct welded connections shall not be made to valves, strainers, equipment, etc. The contractor should be required to obtain certification of all pipe welders on the project, in accordance with Section IX of the ASME code.

D. Union or flanged connections should be provided at valves, equipment, etc. Provide dielectric unions at the junction of steel pipe and equipment with copper piping systems. Or, preferably, provide steel to brass to copper connections. Where size changes on horizontal lines, use reducing fittings having eccentricity down, top level. All piping take-offs should be made from the top of mains or headers. Do not "bullhead" tee connections.

2.3 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Makeup-water piping shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Makeup-Water Piping Installed Belowground and within Slabs: Type K (Type A), annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

C. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

D. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

E. Air-Vent Piping:

1. Provide manual air vents at high points of vertical risers and at each water coil.
2. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
3. Outlet: Type K (Type A), annealed-temper copper tubing with soldered or flared joints.

F. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 232116.

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves, Escutcheons and Sleeve Seals for HVAC Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves, Escutcheons and Sleeve Seals for HVAC Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230517 "Sleeves, Escutcheons and Sleeve Seals for HVAC Piping."

X. Do not use bullhead tees.

3.3 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.

D. Dielectric Fittings for NPS 6 and Larger: Use dielectric flange kits.

3.4 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.

C. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
   2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
   4. Spring hangers to support vertical runs.
   5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 3/4: Maximum span, 7 feet.
   2. NPS 1: Maximum span, 7 feet.
   3. NPS 1-1/2: Maximum span, 9 feet.
   4. NPS 2: Maximum span, 10 feet.
   5. NPS 2-1/2: Maximum span, 11 feet.
   6. NPS 3 and Larger: Maximum span, 12 feet.
E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. **NPS 3/4**: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. **NPS 1**: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. **NPS 1-1/4**: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. **NPS 1-1/2**: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. **NPS 2**: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. **NPS 2-1/2**: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. **NPS 3 and Larger**: Maximum span, 10 feet; minimum rod size, 3/8 inch.

F. Support vertical runs at each floor.

3.5 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

H. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections. Reference floor plans for pipe sizes.
B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections.

3.7 BULLHEAD TEES

A. Do not use bullhead tees.

3.8 WATER DRAINING

A. Provide 3/4" hose end gate valves at low points and bottom of each riser to drain HVAC water systems.

3.9 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.
C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as chillers and heat exchangers to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13
SECTION 23 21 16 - HYDRONIC PIPING, VALVES, AND SPECIALTIES

PART 1 - GENERAL (Not Applicable)

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 125 psig at 200 deg F.
2. Chilled-Water Piping: 125 psig at 200 deg F.
3. Makeup-Water Piping: 80 psig at 150 deg F.
4. Condensate-Drain Piping: 150 deg F.
5. Air-Vent Piping: 200 deg F.
6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 VALVES

A. Ball Valves

1. HVAC Circulating Water Piping: 2" and less Figure T-585-70 or S-585-70, 2-piece, full port, 600 psi, WOG, TFE seats.
2. Provide ball valves with locking handle.
3. Provide extended lever for insulated service.
4. Stainless Steel balls to be used.

B. Butterfly Valves - 2-1/2" And Up:

1. HVAC Circulating Water Piping: Figure LD-2000, lug type, 200 psi, Class 125, EPDM liner, aluminum bronze disc.
2. Butterfly valves rated bubble tight for dead end service at full pressure in both directions without the need for downstream blind flange.
3. Provide hand wheel and closed housing worm gear on valves 8 inches and larger. Provide clamp lock hand lever operators on valves less than 8 inches.

C. Check Valves:

1. HVAC Circulating Water Piping:

   a. System pressures 125 psi and less: Figure 910, non slam.
D. Control Valves:
   1. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."

E. Balancing Valves: Bronze, Calibrated-Orifice
   1. Body: Bronze, ball or plug type with calibrated orifice or venturi.
   2. Ball: Brass or stainless steel.
   3. Plug: Resin.
   4. Seat: PTFE.
   5. End Connections: Threaded or socket.
   7. Handle Style: Lever, with memory stop to retain set position.
   8. CWP Rating: Minimum 125 psig.
   9. Maximum Operating Temperature: 250 deg F.

F. Pressure-Reducing Valves: ASME labeled, Diaphragm-Operated
   2. Disc: Glass and carbon-filled PTFE.
   5. Diaphragm: EPT.
   6. Low inlet-pressure check valve.
   7. Inlet Strainer: Stainless steel, removable without system shutdown.
   9. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Diaphragm-Operated Safety Valves: ASME labeled.
   1. Body: Bronze or brass.
   2. Disc: Glass and carbon-filled PTFE.
   5. Diaphragm: EPT.
   7. Inlet Strainer: Stainless steel, removable without system shutdown.
   9. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

H. Flow Balancing Valve
   1. Type: Similar to B & G "Circuit Sentry", Armstrong "CBV" or Taco "AccuFlow".
   2. Provide calibrated, non-ferrous valve with provisions for connecting a portable differential pressure meter for flow measurement and balance.
   3. Provide meter connections with built-in check valves.
   4. Provide integral pointer to register degree of valve opening with tamper proof memory feature.
5. Provide valve with drain connection.
6. Construct valve with integral seals to prevent leakage around rotating element.
7. Construct valve for 125 psi working pressure at 150 degrees F.
8. Provide preformed polyurethane insulation for easy access to valve without disturbing field applied adjacent insulation.
9. Provide valve with engraved tag attached indicated design flow, pressure, and flow characteristic of station.

2.3 ELECTROMAGNETIC FLOW METER

A. Insertion style electromagnetic flow meter equal to Onicon F-3500 Series.

2.4 AIR-CONTROL DEVICES

A. Manual Air Vents:
   1. Body: Bronze.
   2. Internal Parts: Nonferrous.
   3. Operator: Screwdriver or thumbscrew.
   4. Inlet Connection: NPS 1/2.
   7. Maximum Operating Temperature: 225 deg F.

B. Expansion Tanks:
   1. Expansion tanks shall be bladder type, welded steel, designed, constructed, certified and stamped in accordance with ASME BPVC-VIII-1-2013 for a working pressure of 125 psig at 240 deg F. Bladders shall be replaceable elastomeric butyl rubber type.
   2. Manufacturers: Bell & Gossett, Flo-Fab.

C. In-Line Air Separators:
   1. Centrifugal inline tank type, capable of handling the water flow indicated on the drawings and constructed for 125 psig working pressure.
   2. Manufacturer: Bell & Gossett, Flo-Fab.

2.5 CHILLED WATER BUFFER TANK

A. Vertical, steel construction, designed, constructed, certified, and stamped in accordance with ASME BPVC-VIII-1-2013 for 125 psig working pressure, with base ring or structural steel legs with baseplates.

B. Complete with manhole or inspection opening, air vent connection, lifting lugs, and bottom drain connection.

C. Tanks shall have a vertical internal baffle to prevent stratification. Piping connections shall be as indicated on the Drawings.

D. The exterior of the tanks shall be factory-painted with 2 coats of rust resisting paint.
E. Insulation: Factory-applied 0.75" flexible elastomeric sheet secured with full coverage of adhesive.

F. Insulation: Field-applied, as elastomeric insulation per manufacturer’s installation instructions.

G. Manufacturer: Lochinvar, Reco, Taco, or Wessels, or Wheatley.

2.6 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:
   1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.

B. Stainless-Steel Bellow, Flexible Connectors:
   2. End Connections: Threaded or flanged to match equipment connected.
   4. CWP Rating: 150 psig.
   5. Maximum Operating Temperature: 250 deg F.

C. P.T. Test Plugs:
   1. Provide 1/4 inch solid brass pressure/temperature test plugs at locations shown on drawings.
   2. Nordel self-closing valve to be rated for 275 degrees F. service.
   3. Plugs to be manufactured by Flow Design, Peterson Engineering, SISCO, or equal.

D. Pressure/Temperature Test Kit:
   1. Provide Owner complete portable pressure and temperature test kit.
   2. Kit to be complete with pressure test gauge, necessary connector hoses, temperature test thermometer with adapter, shutoff and vent valves and carrying case.
   3. Readout kit to be manufactured by Bell & Gossett ITT or equal.

E. Pressure Gauges:
   1. Provide 4-1/2 inch dial, liquid filled pressure gauges at locations shown on drawings.
   2. Gauges to be equal to Trerice Model No. 500X with glycerin liquid fill, nylon, steel, or aluminum case, acrylic plastic window, brass movement, phosphor bronze bourdon tube, and brass socket.
   3. Accuracy to be guaranteed within one-half percent.
   4. Select scale range of gauges to indicate design pressure near midpoint of scale.
   5. Provide each gauge with 1/4 inch size, brass construction needle valve equal to Trerice Model No. 735-2.
   6. Provide each gauge with impulse dampener equal to Trerice Model No. 870.
F. Thermometers:
   1. Provide Trerice or equal 9-inch scale, adjustable angle (rear, front, and side), industrial thermometers at locations shown on drawings.
   2. Each thermometer to have aluminum case, clear acrylic plastic window, mercury tubing, scale with white background and black markings, brass stem, and separable brass well with 2-1/2” extension neck.

G. Thermometer Wells:
   1. Provide Trerice or equal stainless steel thermometer wells for water temperature sensors and at other locations shown on drawings.
   2. Test wells to be stainless steel with 2-1/2 inch extension neck and screw plug cap with chain and shall be filled with light clear oil.

2.7 BYPASS CHEMICAL FEEDER - CHILLED AND HOT WATER SYSTEM

A. Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves equal to Dearborn Type AV. Feeder shall be complete with 3/2” fill opening with 1/4 turn quick opening cover that cannot be removed while feeder is pressurized.
   1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
B. Install piping from air separator to expansion tank with a 2 percent upward slope toward tank.

C. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.

D. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
   1. Install tank fittings that are shipped loose.
   2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

E. Install expansion tank on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

F. Chemical Treatment: Install complete systems in accordance with manufacturer's installation instructions. Provide all piping and tubing materials for interconnection of components.

END OF SECTION 23 21 16
SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 PUMPS

A. Pump manufacturer shall furnish and be responsible for the selection, compatibility and performance of each unit consisting of pump, motor, coupling and base plate.

B. Motor horsepower indicated on schedule is selected to allow non-overloading operation of pump. Pumps shall not be selected requiring impeller sizes within 10 percent of maximum impeller size for that pump size and/or have an efficiency of 75 percent or less.

PART 2 - PRODUCTS

2.1 END-SUCTION CENTRIFUGAL PUMPS

A. Provide Bell & Gossett Series 1510 or Flo Fab Series 2000.

B. Description: Factory-assembled, non-overloading, single stage, end suction, horizontally frame-mounted, flexible coupled, bronze fitted, centrifugal type pump.

C. Pump Construction:

1. Casing: Radially split, back-pullout-design, cast iron, with replaceable bronze wear rings, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and flanged connections.

2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.


4. In "Mechanical Seal" Subparagraph below, retain "Buna-N" option for temperature rating of 225 deg F; retain "EPT" option for 250 deg F.

5. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.


7. Mount pump volute solidly to base through a pedestal support.

8. Provide motor rated for inverter duty used for systems with variable frequency drives.

D. Coupling and Base Plate

1. Manufacturer to furnish and mount pump and motor on common steel base plate with drip pan and drain connection.

2. Manufacturer to furnish and mount flexible coupling. Fasten metal coupling guard to pump base plate.
3. **NAMEPLATE:** Provide pump and motor with stainless steel or aluminum nameplate securely fastened to casings. Nameplates to provide all data necessary for equipment identification and replacement.

E. **Motor:** Single speed and rigidly mounted to pump casing with integral pump support.

1. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 “Motor Requirements for HVAC Equipment.”

### 2.2 IN-LINE VERTICALLY MOUNTED PUMPS

A. Volute to be cast iron, designed for 175 psi working pressure, include suction and discharge nozzles of equal size, gauge tappings, and drain fittings.

B. Impeller to be bronze enclosed type, hydraulically and dynamically balanced, keyed to shaft and secured by suitable locking cap screw.

C. Shaft to be steel. Replaceable shaft sleeve to be aluminum bronze. Shaft sleeve to completely cover wetted area under mechanical seal.

D. Standard mechanical seal to be provided to seal off liquid cavity.

E. Pump to be designed so pump internals can be serviced without disturbing connecting pipe.

### 2.3 PUMP SPECIALTY FITTINGS

A. Suction Diffusers and Triple Duty Valves to be manufactured by Bell & Gossett ITT or Flo Fab.

B. Suction Diffuser:

1. Angle pattern.
2. 250-psig pressure rating, cast-iron body and end cap, pump-inlet fitting.
3. Bronze startup and bronze or stainless-steel permanent strainers.
4. Bronze or stainless-steel straightening vanes.
5. Drain plug.
6. Bottom blowdown connection, inlet gauge port and adjustable support foot to carry weight of suction piping.

C. Triple-Duty Valve:

2. Angle or straight pattern.
3. 250-psig pressure rating, cast-iron body, pump-discharge fitting.
4. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
5. Brass gage ports with integral check valve and orifice for flow measurement.
PART 3 - EXECUTION

3.1 PUMP INSTALLATION

A. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

B. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

C. Equipment Mounting:
   1. Install base-mounted pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 03 "Cast-in-Place Concrete."
   2. Comply with requirements for vibration isolation devices specified in Section 230548 "Vibration Isolation for HVAC."

3.2 ALIGNMENT

A. Perform alignment service.

B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

C. Comply with pump and coupling manufacturers' written instructions.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping, Valves and Specialties."

B. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Where installing piping adjacent to pump, allow space for service and maintenance.

D. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

E. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

F. Install triple-duty valve on discharge side of pumps.

G. Install suction diffuser and shutoff valve on suction side of pumps.
H. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

I. Provide one spare set of bearings and seals for each pump supplied.

J. Provide drip pans.

K. Install compound pressure gauges on pump suction and discharge. Reference detail on drawings.

END OF SECTION 23 21 23
SECTION 23 22 13 - STEAM AND CONDENSATE HEATING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Submit pipe, valves, and fittings and have approved before starting installation. Pipe, valves, and fittings to be new and marked clearly with manufacturers' name, weight, and classification or working pressure.

B. Low pressure steam to be up to 15 psi. Medium pressure steam to be up to 60 psi. High pressure steam to be up to 125 psi.

PART 2 - PRODUCTS

2.1 STEEL PIPES

A. Seamless black steel pipe, ASTM A-53, Grade "B", Schedule 40, for the following services:

1. Low/medium/high pressure steam: Schedule 40: all sizes 1/2'' through 12'' IPS.

B. Seamless black steel pipe ASTM A-53, Grade "B", Schedule 80 for the following:

1. Condensate return piping: Schedule 80; sizes 1/2'' through 10'' IPS.

2.2 BRANCH CONNECTIONS

A. Branch connections from mains or headers 2-1/2'' or larger shall be welded tees or welding outlets. Outlets shall be equal to threaded or welded manufactured by Bonney Forge.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.

   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
PART 3 - EXECUTION

3.1 STEAM PIPING APPLICATIONS

A. Steam Piping: Schedule 40, Type Seamless, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

B. Condensate Piping above Grade: Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

C. Condensate Piping below Grade: Schedule 80, Type Seamless, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

3.2 ANCILLARY PIPING APPLICATIONS

A. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

B. Vacuum-Breaker Piping: Outlet, same as service where installed.

C. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless otherwise indicated.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
K. Install drains, consisting of a tee fitting, NPS 3/4 full port-ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

L. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.

M. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.

N. Bushings are not permitted.

O. Reduce pipe sizes using eccentric reducer fitting installed with level side down.

P. Install branch connections to mains using mechanically formed or welded outlets tee fittings in main pipe, with the branch connected to top of main pipe.

Q. Install valves according to Section 232216 "Steam and Condensate Piping Specialties."

R. Install Class 150 malleable iron unions in piping, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and full port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

V. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.

1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 300 feet.
2. Size drip legs same size as main. In steam mains NPS 6 and larger, drip leg size can be reduced, but to no less than NPS 4.

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves, Escutcheons and Sleeve Seals for HVAC Piping."

X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves, Escutcheons and Sleeve Seals for HVAC Piping."

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230517 "Sleeves, Escutcheons and Sleeve Seals for HVAC Piping."
3.4 STEAM AND CONDENSATE PIPING SPECIALTIES INSTALLATION

A. Comply with requirements in Section 232216 "Steam and Condensate Piping Specialties" for installation requirements for strainers, special-duty valves, steam traps, thermostatic air vents and vacuum breakers, and steam and condensate meters.

3.5 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for installation of hangers and supports. Comply with requirements below for maximum spacing.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.

C. Install hangers for steel steam supply piping with the following maximum spacing:

1. NPS 3/4: Maximum span, 9 feet.
2. NPS 1: Maximum span, 9 feet.
3. NPS 1-1/2: Maximum span, 12 feet.
4. NPS 2: Maximum span, 13 feet.
5. NPS 2-1/2: Maximum span, 14 feet.
6. NPS 3 and Larger: Maximum span, 15 feet.

D. Install hangers for steel steam condensate piping with the following maximum spacing:

1. NPS 3/4: Maximum span, 7 feet.
2. NPS 1: Maximum span, 7 feet.
3. NPS 1-1/2: Maximum span, 9 feet.
4. NPS 2: Maximum span, 10 feet.
5. NPS 2-1/2: Maximum span, 11 feet.
6. NPS 3 and Larger: Maximum span, 12 feet.

E. Support vertical runs at each floor, and at 10-foot intervals between floors.

3.6 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be the same as or larger than equipment connections.
B. Install traps and control valves in accessible locations close to connected equipment.
C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
D. Install vacuum breakers downstream from control valve, close to coil inlet connection.

3.8 FIELD QUALITY CONTROL

A. Prepare steam and condensate piping according to ASME B31.9, “Building Services Piping,” and as follows:
   1. Leave joints, including welds, uninsulated and exposed for examination during test.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush system with clean water. Clean strainers.
   4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
C. Manufacturer’s Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   2. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.
   3. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
E. Prepare test and inspection reports.

END OF SECTION 23 22 13
SECTION 23 22 14 - UNDERGROUND STEAM AND CONDENSATE PIPING

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit the following for review:

1. Product data
2. Scaled layout drawing showing all sections of conduit system. Show grades, underground utilities, buildings, pipe invert elevations, locations of anchors, z-bends, oversized elbows and other parts of system.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Rovanco Rhinocoat High Temperature Conduit
B. Perma-Pipe Escon-A/Ferro-shield.

2.2 CLASS A, STEEL SYSTEM

A. The conduit shall be 10 gauge, welded, smooth-wall black steel conforming to ASTM A-211, A-139, A-134, and A-135. Conduit shall be tested at the factory to insure air and watertight welds prior to any fabrication or application of coating. The outside conduit surface shall be blasted to clean, bright metal. Immediately after blasting, the outer conduit surface shall be given a factory coat of Fusion Bond epoxy (FBE). Coating application shall be a minimum of 20 mils thickness.

B. Conduit closures shall be 10-gauge steel, furnished with the conduit at a ratio of one closure for each fabricated item or length. Closures shall be field welded over adjacent units after pipe insulation. After testing, all exposed closures shall be covered in the field with a heat shrinkable sleeve, furnished with the conduit.


D. The pipe insulation shall be rigid preformed 3" mineral wool. Mineral wool specification shall be Class 2, rating of 100 psi at 5% deformation and a "K" factor of no higher than .36 at a mean temperature of 200°F. Thickness shall be as follows:

1. Steam piping - 3 inches thick
2. Condensate return piping - 1-1/2" thick
Installation shall be applied continuously to the pipes without gaps at pipe supports. Split insulation shall be held in place by stainless steel bands not less than 1/2" wide, 32 gauge thick and installed at minimum of 18" centers.

E. Prefabricated ells, loops and tees shall be furnished and installed where shown on plans and shall consist of pipe, insulation, and conduit conforming to the same specification as herein before stated for straight runs. Expansion loops shall be designed in accordance with the stress limits indicated by the Code for Pressure Piping, ASME B31.1. Loop piping shall be installed in conduit suitably sized to handle indicated pipe movement.

F. Factory welding of service piping 6" and larger shall be by submerged arc process. Welding of service piping, including field joints shall conform to the American Standard B31.1, and American Welding Society Standard B3-0.

G. Provide materials and methods to insulate and seal around flanges and valves and transition from the Class A system to steel pipe in the valve. Supervise field installation of materials to insure a complete water-tight seal around the valves, fittings and flanges.

H. Terminal ends of conduits inside manholes, pits or building walls shall be equipped with end seals consisting of a 1/2" steel bulk head plate welded to the pipe and conduit. If there is no anchor within five feet of a terminal end, conduits shall be equipped with gland seals consisting of a packed stuffing box and gland follower mounted on a steel plate welded to the end of the conduit. End seals or gland seals shall be equipped with drain and vent openings. Terminate all conduits 6" beyond the inside face of manhole or building walls.

I. Prefabricated anchors shall be furnished and installed where shown on plans and shall consist of a steel plate, welded to pipe and conduit. The steel anchor plate shall be 1/2" thick and shall be 5" larger horizontally and 2" larger vertically than nominal conduit diameter.

J. A concrete thrust block shall be cast over the anchor plate and conduit, large enough for firm anchorage into undisturbed trench sidewalls and/or bottom. The concrete block shall be at least 36" in length and extend a minimum of 12" beyond the top and bottom of the anchor plate.

K. Expansion/contraction compensation will be accomplished utilizing factory prefabricated and preinsulated expansion elbows, Z-bends, expansion loops and anchors specifically designed for the intended application. External expansion compensation utilizing flexible expansion pads (minimum one inch thickness), extending on either side, both inside and outside the radius of the fittings are used with all fittings having expansion in excess of 1/2".

L. Wall sleeves with leak plates shall be provided at all building and manhole entries to provide an effective moisture barrier. The wall sleeve and leak plate shall be electrically isolated from building rebar. The space between the conduit and wall sleeve shall be made watertight by use of Link-Seal assemblies, which will also provide electrical isolation.

M. Cathodic protection not required.

2.3 MATERIALS AND PUMPED CONDENSATE

A. Carrier pipe, insulation and jacketing material for underground condensate return, and pumped condensate system shall be Class A, steel piping system specified for steam piping under Paragraph 2.2.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Pre-engineered systems shall be provided with all straight pipe and fittings factory preinsulated and prefabricated to job dimensions.

B. Underground systems shall be buried in a trench not less than two (2) feet deeper than the top of the pipe and not less than eighteen inches wider than the combined O.D. of all piping systems. A minimum thickness of 24 inches of compacted backfill placed over the top of the pipe will meet H-20 highway loading.

C. Trench bottom shall have a minimum of 6” of sand, pea gravel, or specified backfill material as a cushion for the piping. All field cutting of the pipe shall be performed in accordance with the manufacturer's installation instructions.

D. A hydrostatic pressure test of the carrier pipe shall be performed per the engineer's specification with a factory recommendation of one and one-half times the normal system operating pressure for not less than two hours. Care shall be taken to insure all trapped air is removed from the system prior to the test. Appropriate safety precautions shall be taken to guard against possible injury to personnel in the event of a failure.

END OF SECTION 23 22 14
SECTION 23 22 16 - STEAM AND CONDENSATE PIPING SPECIALTIES

PART 1 - GENERAL (Not Applicable)

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Armstrong, Sarco and ITT Hoffman

2.2 VALVES

A. Gate Valves:

1. Steam and condensate return, 60 psi and less:

   a. 2" and less, Figure T-134, bronze body, Class 150. SWP ASTM B-62 bronze reversible type with solid wedge disc, tapered seat, rising stem and screwed ends.
   b. 2-1/2" and larger, Figure F617-0, iron body, bronze mounted, Class 125. SWP ASTM A-126 with outside screw and yoke and flanged ends.

2. Steam and condensate return, above 60 psi:

   a. 2" and less, Figure T-174, bronze body, Class 300.
   b. 2-1/2" and up Figure F-667-O, iron body, Class 250.
   c. For high pressure steam piping use forged or cast steel.

B. Globe Valves:

1. Steam and condensate return, 60 psi and less:

   a. 2" and less, Figure T-235, bronze body, threaded ends, Class 150.
   b. 2-1/2" and up, Figure F718-B, iron body, OS&Y, flanged ends, Class 125.

2. Steam and condensate return, above 60 psi:

   a. 2" and less, Figure T-275, bronze body, threaded ends, Class 300.
   b. 2-1/2" and up Figure F-768-B, iron body, bolted bonnet, flanged ends, Class 250.
   c. For high pressure steam piping use forged or cast steel.

3. Sweat: 2" and less, Figure S-235. Solder ends, 300 psi W.O.G.

C. Check Valves:

1. Steam and condensate return, 60 psi and less:

   a. 2" and less, Figure T-433, swing check, bronze disc, screw-in cap, threaded ends, Class 150.
b. 2-1/2" and up, Figure F918, swing check, bronze disc and seat ring, bolted cover, Class 125.

2. Steam and condensate return, above 60 psi:
   a. 2" and less, Figure T-473, swing check, bronze disc, threaded ends, Class 300.
   b. 2-1/2" and up Figure F-968, swing check, bronze disc and set ring, bolted cover, Class 250.
   c. For high pressure steam piping use forged or cast steel.

2.3 STRAINERS
   A. Y-Pattern Strainers:
      1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
      2. Strainers 2 inches and smaller: Iron body, screwed ends, 300 psi steam working pressure (750°F maximum). Furnish strainers with 30 mesh 304 stainless steel or Monel screens.
      4. Strainers 2-1/2" to 8 inches: Iron body, bolted cast iron retainer, flanged ends, 300 psi steam working pressure (750°F maximum). Furnish strainers with stainless steel screen with 3/64 (0.045) inch perforations.
      5. Tapped blowoff plug.
      6. CWP Rating: 300-psig working steam pressure.

2.4 PRESSURE RELIEF VALVES
   A. Provide bronze pressure relief valve equal to Kunkle Figure 252 at each pressure reducing station, ASME labeled.
   B. Select relief valve for the reducing station upstream pressure. Size the relief valve for full installed capacity of the highest pressure reducing valve. Set relief valve to relieve at not more than 20 percent (maximum 10 psig) above the reduced pressure.
   C. Provide each pressure relief valve outlet with drip-pan elbow equal to Kunkle Figure 299.
   D. Provide valve with cast iron body with 250 psi inlet flange and 125 psi outlet connection, and bronze trim.
   E. Provide open-layer type relief valve constructed in accordance with ASME Boiler and Unfired Pressure Vessel Codes (Sections 1 and 8, respectively), and tested and capacity rated by National Board of Boiler and Pressure Vessel Inspections.

2.5 STEAM PRESSURE-REDUCING VALVES
   A. Provide pilot-operated type pressure reducing valves design for use on dead-end service equal to Spirax Sarco 25 P or Watson McDaniel HD Series.
   B. ASME labeled.
   C. Size, Capacity, and Pressure Rating: Factory set for inlet and outlet pressures indicated.
   D. Description: Pilot-actuated, stainless steel diaphragm, valve plug, seat ring guide bushing with adjustable pressure range and positive shutoff.
   E. Body: Cast iron rated for 300 psi steam working pressure.
F. End Connections: Threaded connections for valves NPS 2 and smaller and flanged connections for valves NPS 2-1/2 and larger.

G. Trim: Hardened stainless steel.

H. Head and Seat: Replaceable, main head stem guide fitted with flushing and pressure-arresting device cover over pilot diaphragm.


2.6 PRESSURE GAUGES

A. Provide 4-1/2” dial pressure gauges at locations shown on drawings.

B. Gauges to be equal to Trerice Model No. 500X with nylon, steel, or aluminum case, clear glass or acrylic plastic window, white dial face with black letters and pointer, Monel or bronze rotary movement and nylon gear, phosphor bronze bourdon tube, silver soldered joints, and forged brass socket.

C. Accuracy to be guaranteed with 1/2 percent over middle half of scale ranger and 2 percent of remainder.

D. Select scale range of gauges to indicate design pressure near midpoint of scale.

E. Provide each gauge with 1/4” size, brass construction needle valve equal to Trerice Model No. 735-2.

2.7 STEAM TRAPS

A. Float and Thermostatic Traps:

2. End Connections: Threaded.
3. Float Mechanism: Replaceable, stainless steel.
5. Trap Type: Balanced pressure.
7. Thermostatic air vent capable of withstanding 45 deg F of superheat and resisting water hammer without sustaining damage.

B. Inverted Bucket Traps:

1. Provide inverted bucket type traps with ASTM A-278 Class 30 cast iron body suitable for intermittent operation.
2. Provide stainless steel bucket, valve retainer, and lever with heat treated chrome steel valve and seat.
3. Provide inverted buck traps to drain condensate from high pressure steam main headers and branch lines.
4. Size trap for minimum three times the capacity of the steam header or branch line.
2.8 THERMOSTATIC AIR VENTS AND VACUUM BREAKERS

A. Thermostatic Air Vents:
   1. Body: Cast iron, bronze, or stainless steel.
   2. End Connections: Threaded.

2.9 FLEXIBLE CONNECTORS

A. Stainless-Steel Bellows, Flexible Connectors:
   2. End Connections: Threaded or flanged to match equipment connected.
   4. CWP Rating: 150 psig.
   5. Maximum Operating Temperature: 250 deg F.

2.10 STEAM METER

A. Provide Vortex flow meter equal to Onicon F2600 Series, ANSI Class 150 flange, remote mount transmitter, and Integral temperature and pressure sensor (100 psig).

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.

B. Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.2 PIPING INSTALLATION

A. Install piping to permit valve servicing.

B. Install drains, consisting of a tee fitting, 3/4-inch full port-ball valve, and short 3/4-inch threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

C. Install unions in piping, 2-inch and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

D. Install flanges in piping, 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install strainers on supply side of pressure-reducing valves, traps, and elsewhere as indicated. Install 3/4-inch nipple and full port ball valve in blowdown connection of strainers 2-inch and larger pipe to nearest floor drain. Match size of strainer blowoff connection for strainers smaller than 2-inch.

3.3 STEAM-TRAP INSTALLATION

A. Install union or flanged connection on both ends of trap.

B. Provide gate valve and strainer at inlet side of each steam trap.

C. Provide check valve and gate valve at discharge of each steam trap.

D. Provide a minimum 12" long drip leg and 6" long dirt leg of same pipe size as main steam line or equipment condensate return connection.

E. Do not install thermostatic elements in traps until system has been operated and dirt pockets cleaned of sediment and scale. Provide temporary covers for use prior to final installation of elements.

3.4 PRESSURE-REDUCING VALVE INSTALLATION

A. Install pressure-reducing valves in accessible location for maintenance and inspection.

B. Install bypass piping around pressure-reducing valves, with globe valve equal in size to area of pressure-reducing valve seat ring, unless otherwise indicated.

C. Install gate valves on both sides of pressure-reducing valves.

D. Install unions or flanges on both sides of pressure-reducing valves having threaded- or flanged-end connections, respectively.

E. Install pressure gages on low-pressure side of pressure-reducing valves after the bypass connection.

F. Install strainers upstream for pressure-reducing valve.

G. Install safety valve downstream from pressure-reducing valve station.

3.5 RELIEF VALVE INSTALLATION

A. Install safety valves according to ASME B31.9, "Building Services Piping."

B. Pipe safety-valve discharge without valves to atmosphere outside the building.

C. Install drip-pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.

D. Install exhaust head with drain to waste, on vents equal to or larger than 2-1/2 inch.

END OF SECTION 23 22 16
SECTION 23 22 23 - STEAM CONDENSATE PUMPS

PART 1 - GENERAL (Not Applicable)

PART 2 - PRODUCTS

2.1 CENTRIFUGAL PUMPS WITH FLOOR-MOUNTED RECEIVER

A. Bell & Gossett CBD or Shipco.

B. Description: Factory-fabricated Vertical duplex type, packaged, electric-driven pumps; with elevated receiver, pumps, controls, and accessories suitable for operation with steam condensate.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Provide factory test complete unit certified test report including NPSH characteristics.
3. ASME Compliance: Fabricate and label steam condensate receivers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

C. Configuration: Vertical Duplex floor-mounted pump with receiver and float switches; rated to pump 200 deg F steam condensate.

D. Receiver:

1. Floor mounted.
2. Close-grained cast iron.
3. Externally adjustable float switches.
4. Flanges for pump mounting.
5. Brass Water-level gage and dial thermometer.
6. Pressure gage at pump discharge.
7. Bronze fitting isolation valve between pump and receiver.
8. Lifting eyebolts.
9. Inlet vent and an overflow.

E. Pumps:

1. Centrifugal, close coupled, vertical design.
2. Permanently aligned.
3. Bronze fitted.
4. Replaceable bronze case ring.
5. Mechanical seals rated at 250 deg F.
6. Mounted on receiver flange.
7. Bronze centrifugal impeller.
8. Stainless steel shaft
F. Motor:
   1. Reference Specification Section 230513, "Motors Requirements for HVAC Equipment", except 3500 rpm type.

G. Control Panel:
   1. Factory wired between pumps and float switches, for single external electrical connection.
   2. Provide fused, control-power transformer.
   3. NEMA 250, Type 1 enclosure with hinged door and grounding lug, mounted on pump.
   4. Motor controller for each pump.
   5. Electrical pump alternator to operate pumps in lead-lag sequence and allow both pumps to operate on receiver high level.
   6. Manual lead-lag control to override electrical pump alternator and manually select the lead pump.
   7. Momentary-contact "TEST" push button on cover for each pump.
   9. Disconnect switch for each pump.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install pumps according to manufacturer's installation instructions.
   B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
   C. Support pumps and piping separately so piping is not supported by pumps.
   D. Install thermometers and pressure gages.
   E. Equipment Mounting:
      1. Install pumps on cast-in-place concrete equipment base.

3.2 CONNECTIONS
   A. Comply with requirements for piping specified in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Piping Specialties."
   B. Where installing piping adjacent to machine, allow space for service and maintenance.
   C. Install a globe and check valve and pressure gage before inlet of each pump and a gate and check valve at pump outlet.
   D. Pipe drain to nearest floor drain for overflow and drain piping connections.
   E. Install full-size vent piping to outdoors, terminating in 180-degree elbow at point above highest steam system connection or as indicated.
F. Furnish an extra set of mechanical seals for each pump.

END OF SECTION 23 22 23
PART 1 - GENERAL

1.1 DUCTWORK

A. Low pressure ductwork refers to systems operating at 2.0" w.g. total static pressure with velocities up to 2000 FPM.

B. Provide and/or construct all materials, ductwork, joints, transitions, dampers, access doors, etc., as set forth in these specifications necessary to install the low pressure sheet metal ductwork required by the Mechanical Drawings.

C. Seal all duct openings with plastic during construction. Protect the return/negative pressure side of ductwork system throughout the entire construction period.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with the latest edition of SMACNA "HVAC Duct Construction Standards," (Metal and Flexible) and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA "HVAC Duct Construction Standards" (Metal and Flexible).

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA "HVAC Duct Construction Standards" (Metal and Flexible) based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturer: Eastern Sheet Metal, SEMCO.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows shall be smooth radius with a centerline radius of 1.5 times the duct diameter.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "90 Degree Tees and Laterals," and "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 Duct Access Doors

A. Provide insulated, factory fabricated access doors with dual latches and gaskets along perimeter. Door shall match leakage and pressure class ratings of duct where door is located.

2.4 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.
2.5 JOINT SEALER

A. Manufacturer by Hardcast Inc., Two Stage Sealant Process.
   1. Stage 1: Apply fiber DT tape.
   2. Stage 2: Brush on RTA-50 sealant over fiber tape.

2.6 GASKETS AND SEALS

A. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

B. Round Duct Joint O-Ring Seals:
   1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
   2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
   3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:
   2. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.
PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Seal all low pressure transverse and longitudinal joints with approved sealer in accordance with manufacturer's recommendation instructions.

D. Install round ducts in maximum practical lengths.

E. Install ducts with fewest possible joints.

F. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

G. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

J. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

K. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

L. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233713 "Sheet Metal Specialties" for fire and smoke dampers.

M. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. **Make connections to equipment with flexible connectors.**

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.
3.6 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.7 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:
   1. Ducts Connected Downstream from Terminal Units:
      a. Pressure Class: Positive 2-inch wg.
   2. Ducts Connected to Single Volume Air-Handling Unit #14:
      a. Pressure Class: Positive 2.5-inch wg.
   3. Ducts Connected Variable-Air-Volume Terminal Units:
      a. Pressure Class: Positive 2-inch wg.

C. Return/Exhaust Ducts:
   1. Ducts Connected to Air-Handling Units AHU #14:
      a. Pressure Class: Positive or negative 2-inch wg.

D. Exhaust Ducts:
   1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
      a. Pressure Class: Negative 1-inch wg.
   2. Ducts Connected to Air-Handling Units AHU #13 and AHU #15:
      a. Pressure Class: Positive or negative 2-inch wg.

E. Outdoor-Air Ducts:
   1. Ducts Connected to Air-Handling Units AHU-13, AHU-14, and AHU15:
      a. Pressure Class: Positive or negative 2-inch wg.

F. Intermediate Reinforcement:
G.  Elbow Configuration:

1. Rectangular Duct: Elbows shall be smooth radius with a centerline radius of 1.5 times the duct diameter.

H.  Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

I. Side Takeoff Fittings:

1. Minimum 26 gauge: galvanized steel, designed for minimum pressure drop by an expansion from a rectangular connection to a round duct. The fitting shall include a 1" wide mounting flange with die formed corner clips, prepunched mounting holes, and an adhesive-coated flange gasket. The outlet collar shall be crimped and incorporate a bead.

2. Manufacturer: Crown, of Flexmaster.

END OF SECTION 23 31 13
SECTION 23 31 15 - S: EET METAL DUCTWORK - MEDIUM PRESSURE

PART 1 - GENERAL

1.1 DUCTWORK (AHU-2 & AHU-3)

A. Medium pressure ductwork refers to systems with velocities greater than 2000 fpm operating at a static pressure of 6” or less, but greater than 2” wg.

B. The contractor shall provide and/or construct all materials, ductwork, joints, transformations, fittings, access doors, etc., as set forth in these specifications necessary to install the medium pressure sheet metal ductwork required by the drawings.

C. Seal all duct openings with plastic during construction.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards".

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards", "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2.2 ROUND AND FLAT OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturer: Eastern Sheet Metal, SEMCO.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards" for static class.

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows shall be smooth radius with a centerline radius of 1.5 times the duct diameter.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," "90 Degree Tees and Laterals," and "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards" for static class.

2.3 INTERNALLY INSULATED DOUBLE WALL DUCT AND FITTINGS

A. Construction to be comprised of airtight outer pressure shell, 1" insulation layer, and perforated metal inner line completely covering insulation.

B. Provide outer pressure shell manufactured from galvanized steel meeting ASTM A-525. Duct and fitting construction to be as specified for single wall round and flat oval duct.

C. Provide inner liner manufactured from galvanized steel meeting ASTM A-525 in the following minimum gauges:

<table>
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<th>Diameter or Minor Axis, Inches</th>
<th>0&quot; - 34</th>
<th>35&quot; - 59</th>
<th>60&quot;+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duct, Perforated Inner Liner</td>
<td>28</td>
<td>26</td>
<td>22</td>
</tr>
<tr>
<td>Fitting, Perforated Inner Liner</td>
<td>22</td>
<td>22</td>
<td>22</td>
</tr>
</tbody>
</table>
D. Perforations not to exceed 3/32” diameters. Percentage of open area to equal 13 percent.

E. Support inner liners of both duct and fittings with metal spacers welded in position to maintain spacing and concentricity.

F. Provide inner couplings to align inner lining to maintain airflow conditions equivalent to standard single wall medium-pressure duct joints. Butt joints are not acceptable for inner liner. Accomplish alignment by extending liner of fitting for slip joint into duct or by use of double, concentric coupling with two couplings held by spacers for rigidity and wall spacing. Provide insulation end fitting where internally insulated duct connects to uninsulated duct or fitting, fire damper, or flex to bring outer pressure shell down to nominal size.

G. Duct Access Doors

1. Provide double wall, insulated, factory fabricated access doors with dual latches and gaskets along perimeter. Door shall match leakage and pressure class ratings of duct where door is located.

2.4 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards" for acceptable materials, material thicknesses, and duct construction methods for static class. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.5 JOINT SEALER

A. Manufactured by Hardcast Inc., Two Stage-Sealant Process.

1. Apply fiber DT tape.
2. Brush on RT A-50 sealant over fiber tape.

2.6 GASKETS AND SEALS

A. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

B. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:
   2. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards" for static pressure.

C. Seal all low pressure transverse and longitudinal joints with approved sealer in accordance with manufacturer's recommendation instructions.

D. Install round ducts in maximum practical lengths.

E. Install ducts with fewest possible joints.

F. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

G. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

J. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
K. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

L. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233713 "Air Duct Accessories" for fire and smoke dampers.

M. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Reference Architectural Drawings (ceiling plans) for locations where ductwork is exposed.

B. All exposed ductwork shall be fabricated from paint grip sheet metal.

C. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

D. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

E. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

F. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

G. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards."

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.
C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233713 "Sheet Metal Specialties."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.7 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Intermediate Reinforcement:


C. Elbow Configuration:

1. Rectangular Duct: Elbows shall be smooth radius with a centerline radius of 1.5 times the duct diameter.

D. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards," "Branch Connection for medium pressure ductwork."

   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Spun long radius bellmouth connections to be used at each round take off from medium pressure duct mains and plenums.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards," "90 Degree Tees and Laterals," and "Conical Tees." Saddle taps are permitted in existing duct.
E. Side Takeoff Fittings:

1. Minimum 26 gauge: galvanized steel, designed for minimum pressure drop by an expansion from a rectangular connection to a round duct. The fitting shall include a 1” wide mounting flange with die formed corner clips, prepunched mounting holes, and an adhesive-coated flange gasket. The outlet collar shall be crimped and incorporate a bead.

2. Manufacturer: Crown, of Flexmaster.

3.8 LEAK TESTING

A. Install medium pressure ductwork to be pressurized to 50% over design operating pressure of 6” wg. whichever is greater. Air leakage at test pressure to be measured by a calibrated orifice type flow meter. Total allowable leakage of system shall not exceed 1/2 of 1% of system air handling capacity.

END OF SECTION 23 31 15
SECTION 23 34 23 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Twin City, Cook or approved equal.

B. Housing: Removable, All aluminum housing roof mounted, belt driven, down blast centrifugal exhaust fan; square, one-piece, aluminum base with venturi inlet cone.

1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Belt Drives:

1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
5. Fan and motor isolated from exhaust airstream.

E. Accessories:

1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
2. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.

2. Overall Height: 12 inches.

2.2 IN-LINE MIXED FLOW CENTRIFUGAL FAN (STEAM ROOM VENTILATION)

A. Twin City, Cook or approved equal.
B. Housing: Housings constructed from heavy-gauge steel and shall be continuously welded.
C. Mixed flow impeller with airfoil die-formed continuously welded blades.
D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
F. Accessories:
   1. Companion Flanges: For inlet and outlet duct connections.
   2. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
   3. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
   4. Bolted access door

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Motor Requirements for HVAC Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
B. Enclosure Type: Totally enclosed, fan cooled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fans in accordance with manufacturer's published instructions.
B. Secure centrifugal roof mounted fans to curbs with stainless steel screws.
C. Connect ducts to fans to allow for straight and smooth airflow.
D. Provide flexible connections between fans and ducts.
E. Install fans level.
F. Check fan alignment and balance. Correct improperly aligned or vibrating fans.

G. Final installation to be free of leaks.

H. Ensure fans are interlocked with appropriate systems and/or controls.

END OF SECTION 233423
SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 REQUIREMENTS

A. Variable volume air terminal units to be pressure independent, single duct, DD control type with hot water reheat coil as manufactured by Johnson Controls or Titus.

PART 2 - PRODUCTS

2.1 VARIABLE VOLUME AIR TERMINAL UNITS

A. Provide pressure independent, single duct, DDC control type with hot water reheat coil as manufactured by Johnson Controls or Titus. Provide units complete with pressure taps and airflow curves for making airflow and pressure measurements. Terminal units to be pressure independent. Terminal unit airflow to be monitored by an integral, multiple point, averaging airflow sensing ring or cross to maintain constant airflow within 5 percent of rated cfm down to 25 percent of nominal cfm, independent of changes in system static pressure. Factory set, field adjustable settings for terminal unit maximum and minimum airflows to be provided in accordance with schedule on drawings. Integral flow taps and calibration chart to be provided for each terminal unit.

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Provide terminal units with minimum 22-gauge welded steel housing. Casing shall be internally lined with 1/2" thick fiberglass insulation.

1. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
2. Air Outlet: S-slip and drive connections, size matching inlet size.
3. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 6-inch wg inlet static pressure.

E. Hydronic Heating Coils: Provide factory mounted hot water reheat coils. Coils shall have a minimum .025 inch thick copper tube, with mechanically bonded aluminum fins. Design for minimum 200 psig and 220° F. Aluminum fins shall be a minimum of .0075 inch thick and spaced at a maximum of 12 fins/inch. Headers shall be heavy cast iron or steel. Designs shall be for a minimum operation of 200 psig at 220 degrees F. Coil casing shall be insulated with fiberglass duct wrap.
G. Maximum room N.C. due to discharge or radiated sound shall not exceed NC-35 when terminals are either in throttled or full open position with inlet static pressure ranging from 0.5 to 2" w.g. Correction of noise excesses not to constitute additional charges.

F. Controls:

1. Terminal units to be complete with factory installed, direct digital control actuator for connection to DDC controls provided by control contractor.
2. Coordinate controls with control contractor.

2.2 CASING LINER

A. Casing Liner: 1/2-inch thick elastomeric closed cell foam insulation. Insulation to be UL listed and meet NFPA-90A and UL-181 requirements.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to AHRI 880. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, and AHRI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide 3 diameters of straight duct at entrance to the terminal box. Final tie-in to the box shall be properly aligned so as not to restrict airflow into the box.

3.2 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
3.3 TERMINAL UNIT INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain 36" clear on VAV terminal unit for piping and control access.

C. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.

D. Hot-Water Piping: Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping, Valves, and Specialties," and connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

E. Comply with requirements in Section 233113 "Sheet Metal Ductwork - Low Pressure" for connecting ducts to air terminal units.

F. Make connections to air terminal units with flexible connectors complying with requirements in Section 233713 "Sheet Metal Specialties."

G. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

END OF SECTION 23 36 00
SECTION 23 37 13 - SHEET METAL SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Grilles, registers and diffusers shall be provided with frames, borders, and mounting attachments for installation in the actual wall, soffit and ceiling construction in which installed.

PART 2 - PRODUCTS

2.1 AIR DISTRIBUTION

A. See HVAC Schedule for air distribution devices.

B. Decorative Return Grille - Auditorium
   1. Provide "Architectural Grille" perforated bronze "Square Link 200" with custom anodized finish selected by Architect.

C. Fresh Air Supply Grille – Serving Rooms with Fan Coil Units

2.2 FIRE DAMPERS

A. Fire dampers to be U.L. listed Dynamic in accordance with UL-555. Fire dampers to be held in an open position with a 165 degree F fusible link and arranged to lock in position on closure.

B. Fire dampers for rectangular duct to be type "B" and for round duct to be Type "C". Fire dampers for ductwork with a static pressure rating greater than 2" wg shall be Type "C". Fire dampers located behind sidewall registers and grilles and others specifically indicated on drawings to be Type "A". Fire dampers to be multi-leaf type with spring closing for horizontal mounting and weighted-gravity closing for vertical mounting. Dampers to be steel construction with rust resistant finish and provided with a factory-installed mounting sleeve suitable for structure. Mount per manufacturer's published U.L. approved installation instructions.

C. See Architectural drawings for hour-rating of walls and/or floors. Dampers to be compatible with hour ratings.

2.3 COMBINATION FIRE AND SMOKE DAMPERS

A. Low pressure ductwork: Ruskin Model FSD-36.

C. Install and mount qualified operator at time of fabrication by damper manufacturer. Furnish damper and operator by a single entity meeting applicable UL 555S qualifications for both damper and operator. Damper operator shall be of adequate size to open or close damper in 15 seconds.

2.4 SMOKE DAMPERS
A. Low pressure duct (2" pressure class and lower): Ruskin SD-35.
B. Medium pressure duct (4" - 6" pressure class): Ruskin SD-60.
C. Operators: Electric.
D. Install and mount qualified operator at time of fabrication by damper manufacturer. Operator shall be mounted out of airstream in accessible location. Furnish damper and operator by a single entity meeting applicable UL 555S qualifications for both damper and operator. Damper operator shall be adequate size to open or close damper in 15 seconds.

2.5 SLEEVES
A. Unless otherwise required by the authority having jurisdiction, sleeves for fire dampers and fire and smoke combination dampers shall be the rigid type of construction recommended in Schedule 2 of SMACNA Publication for "Fire Damper and Heat Stop Guide for Air Handling Systems". Use 16 gauge for ducts 24" or less in diameter or either rectangular dimension and 14 for ducts over 24". Provide minimum 18" long sleeves. Coordinate required length with wall thicknesses.
B. Conform to the requirements of UL 555S. Test damper and operator as a unit to comply with UL 555S.
C. Install 1-1/2" x 1-1/2" x 1/8" angle bar on four sides of sleeves and both sides of wall.
D. Fasten angles to sleeve only.
E. Do not fasten angles to the wall.

2.4 MANUAL VOLUME DAMPERS
A. Type: Opposed blade.
B. Material: Steel, 3V type blades mounted in steel channel frame.
C. Shaft: 1/2" square rod operator with end bearings and gasket seal at duct penetrations. Terminate shaft in damper frame with bushings.
D. Operator: Locking quadrant handle with damper position indicator and insulation stand off mounting bracket for externally insulated ductwork.
2.5 FLEXIBLE CONNECTORS

A. Install UL listed flexible duct connectors between duct and fan/equipment connections. Flexible duct connectors to be made of 28-ounce, heavy glass fabric double coated with neoprene.

2.6 DUCT ACCESS DOORS

A. Duct access doors to be provided for access to all coils, fire dampers, automatic and backdraft dampers, duct smoke detectors, static pressure and air volume sensing devices, and other equipment installed in ducts and at other points indicated on drawings.

B. Access door construction and air tightness must be suitable for the duct pressure class used (low, medium, or high).

C. Access doors to be double-panel, galvanized steel construction with minimum 1" rigid insulation between panels. Access doors in exhaust duct may be uninsulated single panel, galvanized steel construction. Doors to mount in rigid frame constructed of formed galvanized steel. Angle iron bracing to be used as required to provide rigid assembly. Doors to hinge on one side with door latch on opposite side.

D. Access doors in ductwork shall fully comply with Figure 2-12 and 2-13 of SMACNA manual. Casing access doors shall fully comply with Figure 6-11 and 6-12 of SMACNA manual.

E. Doors to close against gasket seal.

F. Ductwork and/or equipment access doors shall be required at all motorized dampers, fire dampers, smoke detectors, airflow monitoring stations, duct-mounted temperature/pressure sensors and/or transmitters, vaned elbows, and any other mechanical and/or control device requiring inspection, maintenance or test access. In addition, 24" x 24" access doors shall be utilized wherever possible to facilitate adequate access for maintenance and/or testing.

2.7 FLEXIBLE DUCT

A. Acceptable manufacturers:

1. Flexmaster U.S.A., Model No. Type 5 insulated; Wiremold; Omniair 1200; J.P. Lanburn.

B. Characteristics of flexible duct to air terminals:

1. Approved as UL Class 1 air duct.
2. Flame spread less than 25, smoke developed rating less than 50.
3. Insulated with 1/2" thick fiberglass insulation.
4. Do not exceed four (4) feet flexible duct upstream of diffusers.
5. Flexible duct shall meet standards of local building code.

C. Seal off the insulation jacket as its ends and at joints with mastic, hardcast, or similar material. Replace flex if jacket is punctured.

D. Install flexible duct without kinks or sags and support with 3/4" wide metal bands.

E. Do not route flexible duct through corridor walls, fire or smoke partitions.
F. No bends shall be made in flexible duct with the center line radius less than one and one-half duct diameter and only one bend may occur per four foot length of duct material.

2.8 BACKDRAFT DAMPERS

A. Backdraft Dampers (BDD): Backdraft dampers to be Ruskin Model CBD6 or approved equal low-leak counterbalanced backdraft dampers. Dampers to be heavy-duty type suitable for air velocities to 2500 fpm with all extruded aluminum construction, minimum 0.81" thick frame, and minimum .050" thick blades on maximum 4" centers. Provide blades with vinyl edge seals. Provide dampers with aluminum linkage and corrosion resistant type bearings. Provide dampers with adjustable counterbalances on blades to assist closing.

2.9 ROOF HOODS

A. Fabricate air inlet or relief hoods in accordance with SMACNA Low Pressure Duct Construction Standards.

B. Fabricate of 0.081 gauge extruded aluminum tiers welded to a minimum 8 gauge aluminum support structure. The aluminum hood shall be constructed of minimum 0.063 aluminum and provided with a layer of anti-condensate coating. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. Birdscreen constructed of 1/2" galvanized mesh shall be mounted across the relief opening.

C. Mount unit on minimum 14 inch high curb base with insulation between duct and curb.

E. Provide counterbalanced, adjustable barometric dampers in all relief hoods.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install sheet metal accessories in locations shown on drawings.

B. Install accessories in accordance with manufacturer's published recommendations as well as applicable sections of SMACNA manual and other standards set forth in Part 1.

C. Provide all screw, bolts, nuts, inserts, and material required for attaching sheet metal to duct, walls, floors, and ceilings.

D. Install spin-in fitting with balancing damper in duct runout.

E. Provide minimum 24" x 24" access door in inaccessible ceilings and walls where needed for access to any inaccessible duct access doors or other mechanical equipment including valves, dampers, VAV boxes, etc.
3.2 TESTING

A. Check work for satisfactory installation and performance.

B. Insure that adequate access does in face exit for fire and smoke dampers and that damper operator motors are not hindered in operation by proximity to walls or other objects.

C. Check duct connections at access doors for air leakage or condensation. Correct conditions found.

END OF SECTION 23 37 13
SECTION 23 41 00 - AIR FILTERS

PART 1 - GENERAL (Not Applicable)

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance:
   1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
   2. Comply with ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.
   3. All filters to meet NFPA 90A requirements for flammability.

B. Comply with NFPA 90A and NFPA 90B.

2.2 MERV-8 DISPOSABLE FILTERS

A. Provide 30% medium efficiency, disposable, pleated media filters equal to Farr 30/30/ with a minimum rating of MERV-8 per ASHRAE 52.2 - 1999.

B. Each filter shall consist of a non-woven cotton media, media support grid, and enclosing frame.

C. Filter shall be listed by UL as Class II.

D. Average efficiency of MERV-8 on ASHRAE Test Standard 52.2-1999.

E. 2-Inch Thick Media: Effective filter media area shall not be less than 4.6 square feet of media per square foot of face area.

F. Provide one complete set of replacement filters to Owner at job completion.

2.3 FILTER GAUGES

A. Manometer-Type equal to Dwyer inclined tube draft gage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install filter gage for each filter bank for each air handling unit.
B. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

C. Install filter-gage, static-pressure taps upstream and downstream from filters. Install filter gages on filter banks with separate static-pressure taps upstream and downstream from filters. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.

D. Coordinate filter installations with duct and air-handling-unit installations.

E. Contractor shall provide a new set of clean filters during construction bi-weekly if unit is operating.

F. Protect cooling coils and heating coils with filter media during construction.

G. Install temporary filters over grilles and openings on weekly basis during construction.

END OF SECTION 23 41 00
PART 2 - PRODUCTS

2.1 SHELL-AND-TUBE HEAT EXCHANGER

   A. Manufacturers: Bell & Gossett ITT Type SU or approved equal.

   B. Description: Two-pass, shell and tube construction with "U-bend" removable tube bundle, steam in shell, water in tubes.

   C. Construction: Fabricate and label heat exchangers to comply with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1. Unit shall be stamped with ASME "U" symbol.

   D. Configuration: U-tube with removable bundle.

   E. Shell: Material Steel construction rated for 250 psi working pressure at 375 degrees F.

   F. Head:

      1. Materials: Cast iron.
      2. Flanged and bolted to shell.

   G. Tube:

      1. Seamless copper tubes.
      2. Tube diameter is determined by manufacturer based on service.
      3. Tube side shall be rated for 250 psi working pressure at 375 degrees F.

   H. Tubesheet Materials: Steel.

   I. Piping Connections:

      1. NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.
      2. NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

   J. Support Saddles:

      1. Fabricated of material similar to shell.
      2. Fabricate foot mount with provision for anchoring to support.
      3. Fabricate attachment of saddle supports to pressure vessel with reinforcement strong enough to resist heat-exchanger movement during seismic event when heat-exchanger saddles are anchored to building structure.
PART 3 - EXECUTION

3.1 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of domestic-water heat exchanger that fail in materials or workmanship within specified warranty period.

1. Warranty Periods: From date of Substantial Completion.
   a. Shell-and-Tube Steam/Hot Water Heat Exchanger:
      1) Tube Coil: One year.
      2) Other Components: One year.

3.2 INSTALLATION

A. Equipment Mounting:
   1. Install heat exchanger on cast-in-place concrete equipment base.

B. Install shell-and-tube heat exchangers on saddle supports and structural frame at 5'-0" AFF.

C. Comply with requirements for piping specified in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping, Valves, and Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

D. Comply with requirements for steam and condensate piping specified in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 "Steam and Condensate Piping Specialties."

E. Maintain manufacturer's recommended clearances for tube removal, service, and maintenance.

F. Install piping adjacent to heat exchanger to allow space for service and maintenance of heat exchangers. Arrange piping for easy removal of heat exchanger.

G. Install shutoff valves at heat-exchanger inlet and outlet connections.

H. Install relief valves on heat-exchanger heated-fluid connection and install pipe relief valves, full size of valve connection, to floor drain.

I. Install vacuum breaker at heat-exchanger steam inlet connection.

J. Install hose end valve to drain shell.

K. Install thermometer on heat-exchanger and inlet and outlet piping, and install thermometer on heating-fluid inlet and outlet piping. Comply with requirements for thermometers specified in Section 232116 "Hydronic Piping, Valves, and Specialties."

L. Install pressure gages on heat-exchanger and heating-fluid piping. Comply with requirements for pressure gages specified in Section 232216 "Steam and Condensate Piping Specialties."
3.3 CLEANING

A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

END OF SECTION 23 57 00
SECTION 23 64 23 - SCROLL WATER CHILLERS

PART 1 - GENERAL (NOT USED)

PART 2 - PRODUCTS

2.1 PACKAGED AIR-COOLED WATER CHILLERS

A. Acceptable Manufacturers: York YLAA and Carrier 30RB Scroll Type Chillers.

B. Factory-assembled and run-tested water chiller complete with base and frame, condenser casing, compressors, compressor motors and motor controllers, evaporator, condenser coils, condenser fans and motors, electrical power, controls, and accessories.

C. Fabricate base, frame, and attachment to water chiller components strong enough to resist movement during a seismic event when water chiller base is anchored to field support structure.

D. Cabinet:

1. Base: Galvanized-steel base extending the perimeter of water chiller. Secure frame, compressors, and evaporator to base to provide a single-piece unit.
2. Frame: Rigid galvanized-steel frame secured to base and designed to support cabinet, condenser, control panel, and other chiller components not directly supported from base.
4. Finish: Coat base, frame, and casing with a corrosion-resistant coating capable of withstanding a 500-hour salt-spray test according to ASTM B 117.
5. Sound-reduction package consisting of the following:
   a. Acoustic enclosure around compressors.
   b. Reduced-speed fans with acoustic treatment.
   c. Designed to reduce sound level without affecting performance.
6. Security Package: Provide security grilles with fasteners for additional protection of compressors, evaporator, and condenser coils. Grilles shall be coated for corrosion resistance and shall be removable for service access.

E. Compressors:

1. Description: Positive-displacement direct drive with hermetically sealed casing.
2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.
3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug, and initial oil charge.
F. Compressor Motors:
   1. Hermetically sealed and cooled by refrigerant suction gas.
   2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.

G. Compressor Motor Controllers:
   1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.

H. Refrigeration:
   1. Refrigerant: R-410a. Classified as Safety Group A1 according to ASHRAE 34.
   2. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
   3. Refrigerant Circuit: Each circuit shall include a thermal-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
   4. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.

I. Evaporator:
   1. Brazed-plate or shell-and-tube design, as indicated.
   2. Shell and Tube:
      a. Description: Direct-expansion, shell-and-tube design with fluid flowing through the shell and refrigerant flowing through the tubes within the shell.
      b. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
      c. Shell Material: Carbon steel.
      d. Shell Heads: Removable carbon-steel heads with multipass baffles designed to ensure positive oil return and located at each end of the tube bundle.
      e. Shell Nozzles: Fluid nozzles located along the side of the shell and terminated with mechanical-coupling end connections for connection to field piping.
      f. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.
   3. Brazed Plate:
      a. Direct-expansion, single-pass, brazed-plate design.
      b. Type 316 stainless-steel construction.
      c. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
      d. Fluid Nozzles: Terminate with mechanical-coupling end connections for connection to field piping.
   4. Heater: Factory-installed and wired electric heater with integral controls designed to protect the evaporator to minus 20 deg F.
5. Remote Mounting: Designed for remote field mounting where indicated. Provide kit for field installation.

J. Air-Cooled Condenser:

1. Plate-fin coil with integral subcooling on each circuit, rated at 450 psig.
   a. Construct coils of copper tubes mechanically bonded to copper fins.
   b. Coat coils with a baked epoxy corrosion-resistant coating after fabrication.
   c. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.

2. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades, arranged for vertical air discharge.

3. Fan Motors: Totally enclosed nonventilating (TENV) or totally enclosed air over (TEAO) enclosure, with permanently lubricated bearings, and having built-in overcurrent- and thermal-overload protection.

4. Fan Guards: Steel safety guards with corrosion-resistant coating.

K. Electrical Power:

1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to water chiller.

2. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key.

3. Wiring shall be numbered and color-coded to match wiring diagram.

4. Install factory wiring outside of an enclosure in a raceway.

5. Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch.

6. Provide branch power circuit to each motor and to controls with one of the following disconnecting means:
   a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
   b. NEMA KS 1, heavy-duty, nonfusible switch.
   c. NEMA AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

7. Provide each motor with overcurrent protection.

8. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.


10. Provide power factor correction capacitors to correct power factor to 0.95 at full load.

11. Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
   a. Power unit-mounted controls.
   b. Power unit-mounted, ground fault interrupt (GFI) duplex receptacle.


13. Indicate the following for water chiller electrical power supply:
a. Current, phase to phase, for all three phases.
b. Voltage, phase to phase and phase to neutral for all three phases.
c. Three-phase real power (kilowatts).
d. Three-phase reactive power (kilovolt amperes reactive).
e. Power factor.
f. Running log of total power versus time (kilowatt hours).
g. Fault log, with time and date of each.

L. Controls:

1. Stand-alone, microprocessor based.
2. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.
3. Operator Interface: Keypad or pressure-sensitive touch screen. Multiple-character, backlit, liquid-crystal display or light-emitting diodes. Display the following:
   a. Date and time.
   b. Operating or alarm status.
   c. Operating hours.
   d. Outside-air temperature if required for chilled-water reset.
   e. Temperature and pressure of operating set points.
   f. Entering and leaving temperatures of chilled water.
   g. Refrigerant pressures in evaporator and condenser.
   h. Saturation temperature in evaporator and condenser.
   i. No cooling load condition.
   j. Elapsed time meter (compressor run status).
   k. Pump status.
   l. Antirecycling timer status.
   m. Percent of maximum motor amperage.
   n. Current-limit set point.
   o. Number of compressor starts.

4. Control Functions:
   a. Manual or automatic startup and shutdown time schedule.
   b. Entering and leaving chilled-water temperatures, control set points, and motor load limit.
      Chilled-water leaving temperature shall be reset based on return-water temperature.
   c. Current limit and demand limit.
   d. External water chiller emergency stop.
   e. Antirecycling timer.
   f. Automatic lead-lag switching.

5. Manual-Reset Safety Controls: The following conditions shall shut down water chiller and require manual reset:
   a. Low evaporator pressure or high condenser pressure.
   b. Low chilled-water temperature.
   c. Refrigerant high pressure.
   d. High or low oil pressure.
   e. High oil temperature.
   f. Loss of chilled-water flow.
g. Control device failure.

6. BAS Communications: BAC net MS/TP

M. Insulation:
   1. Material: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I, for tubular materials and Type II, for sheet materials.
   2. Thickness: 1-1/2 inches.
   3. Factory-applied insulation over cold surfaces of water chiller components.
      a. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.
   4. Apply protective coating to exposed surfaces of insulation.

N. Accessories:
   1. Factory-furnished, chilled-water flow switches for field installation.
   2. Individual compressor suction and discharge pressure gages with shutoff valves for each refrigeration circuit.
   3. Factory-furnished neoprene or spring isolators for field installation.

2.2 SOURCE QUALITY CONTROL

   A. Perform functional test of water chillers before shipping.
   B. Factory test and inspect evaporator according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.
   C. Rate sound power level according to ARI 370 procedure.

PART 3 - EXECUTION

3.1 WATER CHILLER INSTALLATION

   A. Install water chillers on support structure indicated.
   B. Equipment Mounting:
      1. Install water chillers on grade on a 6" thick concrete pad.
      2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Isolation for HVAC."
   C. Maintain manufacturer's recommended clearances for service and maintenance.
   D. Charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.
E. Provide 5 year compressor warranty. Manufacturer shall warrant all equipment and material of its manufacture against defects in workmanship and material for a period of eighteen (18) months from date of shipment or twelve (12) months from date of start up, whichever occurs first.

F. Install separate devices furnished by manufacturer and not factory installed.

3.2 CONNECTIONS

A. Comply with requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping, Valves, and Specialties. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to chiller to allow service and maintenance.

C. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, flow meter, and drain connection with valve. Make connections to water chiller with a union, flange, or mechanical coupling.

D. Connect each drain connection with a union and drain pipe and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection if required.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
2. Verify that pumps are installed and functional.
3. Verify that thermometers and gages are installed.
4. Operate water chiller for run-in period.
5. Check bearing lubrication and oil levels.
7. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
10. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

D. Prepare a written startup report that records results of tests and inspections.

END OF SECTION 23 64 23
SECTION 23 73 13 - MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 DESCRIPTION
A. Provide Indoor 100% outdoor air Air Handling Unit, single zone variable volume air handling unit and a variable volume air handling unit.

1.2 PERFORMANCE REQUIREMENTS
A. Certify unit components in accordance with ARI Standard 430 as applicable.
B. Certify coils in accordance with ARI Standard 410.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. York/JCI, Carrier, and Trane.

2.2 UNIT CASINGS
A. Unit shall be double wall constructed in all sections.
   1. Exterior wall shall be minimum 18 gauge galvanized steel. Interior wall shall be minimum 20 gauge solid galvanized steel except at fan section which shall be perforated.
   2. All portions of the interior of the unit exposed to the airstream shall be covered with steel. Foil facing airstream is not acceptable. Insulate all sections with 2" thick 1-1/2lb matt faced fiberglass between two sheets of solid galvanized steel.
   3. The unit shall be supplied with full height, galvanized, double wall, hinged, removable access doors. Provide vent lock style handle that can be opened from unit interior.
   4. Provide IAQ drain pan under coil module. The drain pan shall be also provided under the complete supply fan section. Drain pans shall be stainless steel, double wall construction. Slope and construct drain pans to prevent standing water. Locate drain connection at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

B. Air-Handling-Unit Mounting Frame: Formed galvanized-steel channel or structural channel supports, designed for low deflection, welded with integral lifting lugs.
2.3 FANS

A. Provide supply fan section with plenum fan designed and suitable for class of service indicated in the unit schedule. Fan shaft to be properly sized and protectively coated with lubricating oil. Fan shafts shall be solid and properly designed so that fan shaft does not pass through first critical speed as unit comes up to rated RPM. Fans shall be statically and dynamically tested as an assembly at the required RPM to meet design specifications. Fan wheel shall be properly secured to shaft to prevent slippage.

B. Provide internal factory mounted canvas duct connection at fan discharge connection to fan module.

C. Provide self-aligning, grease lubricated pillow-block ball bearings with lubrication fittings. Provide extended grease lines to drive side of unit casing, for all fan bearings, rigidly attached for easy service access. Units shall include access doors on both sides of the units. All bearings shall perform to L-50 200,000 hour average life.

D. Fan, motor and drive shall be factory mounted with manufacturer's standard vibration isolation devices having a minimum of 2 inches static deflection.

2.4 MOTORS AND DRIVES

A. Fan motors to be mounted and isolated on the same integral base as the fan.

B. Fan motors shall be heavy duty, premium efficiency open drip-proof. See Section 23 05 13. Furnish "VFD Duty" motor for units with variable speed drives.

C. Factory Mount Fan Drives: Make final alignment and belt adjustment after installation. Design drive for 1.5 service factor.

2.5 AIR FILTRATION SECTION

A. Reference Section 234100.

2.6 COILS

A. Hot Water Preheat Coil:
   1. Coil to be constructed of 5/8" outside diameter tubing (0.024 inch thick) with minimum .009" thick aluminum fins and cast iron or copper headers. Bond fins by mechanical expansion.
   2. Provide coils with a maximum working pressure of 175 psig at 200 degrees F.
   3. Provide circuited drainable coils with vent connection at highest point and drain connection at lower point.

B. Hot Water Heating Coil:
   1. Coil to be constructed of 5/8" outside diameter tubing (0.024 inch thick) with minimum .009" thick aluminum fins and cast iron or copper headers. Bond fins by mechanical expansion.
   2. Provide coils with a maximum working pressure of 175 psig at 200 degrees F.
   3. Provide circuited drainable coils with vent connection at highest point and drain connection at lower point.
C. Chilled Water Cooling Coil:
   1. Coil to be constructed of 5/8" outside diameter tubing (0.024 inch thick) with not more than 11 fins per inch with minimum .009" thick aluminum fins and cast iron or copper headers. Bond fins by mechanical expansion.
   2. Provide coils with a maximum working pressure of 175 psig at 200 degrees F.
   3. Provide circuited drainable coils with vent connection at highest point and drain connection at lower point.

2.7 ACCESS SECTIONS
   A. Access sections shall be supplied between unit sections as show on drawings. Access doors shall be provided on both sides of section.

2.8 ADDITIONAL SECTIONS
   A. Double Wall Filter Section
      1. Refer to Section 234100 "Air Filters".
      2. Provide factory-built filter section complete with filters as specified herein. Minimum filter area to be as specified on unit schedule but not to exceed 500 fpm filter face velocity. Filter sections to have full sized, hinged, latched, double wall access doors on both sides of section for filter service.
      3. Provide medium efficiency (MERV 8), 2" thick pleated disposable type panel filters equal to Farr 30/30.
      4. Provide a factory mounted Dwyer inclined tube draft gage across each filter section and mark gage to indicate design clean and dirty loading conditions.
      5. Provide one complete set of replacement filters to Owner at job completion.

   B. Double wall mixing section to have low-leak type outside and return air dampers with parallel blades. Arrange dampers so outside and return air merge when entering mixing box. Damper rods to rotate in nylon bushings.

   C. Provide large coil access section for placement at chilled water coil, hot water coil, filter mixing section, and fan. Access doors shall be located on both sides of sections. Doors shall be full sized, hinged, latched, and double wall.

2.9 DAMPERS
   A. Dampers shall have airfoil blades with extruded vinyl edge seals and flexible metal compressible jamb seals. Dampers shall have a maximum leakage rate of 4 cfm/square foot at 1" w.c.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Rigidly install Air Handling Unit modules and base rails on a concrete curb sufficient height to install properly sized condensate drain
B. Connect condensate drain pans using 1-1/2, ASTM B 88, Type M (ASTM B 88M, Type C) copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

C. Arrange installation of units to provide access space around air-handling units for service and maintenance.

D. Install duct connections to each unit to allow for straight and smooth air flow. Do not install turns at the fan discharge which are in the opposite direction to the fan wheel and rotation.

E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

F. Comply with requirements for piping specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

G. Install piping adjacent to air-handling unit to allow service and maintenance.

H. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.

I. Hot- and Chilled-Water Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping, Valves, and Specialties." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

J. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233713 "Sheet Metal Specialties."

END OF SECTION 23 73 13
SECTION 23 82 19 - FAN COIL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes vertical fan coil units.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.

2.2 VERTICAL FAN COIL UNITS

A. Provide JCI, Trane or approved equal.

B. Fabricated of heavy gauge galvanized steel panels insulated with antimicrobial elastomeric closed cell foam insulation. Unit shall have exterior panel fabricated of not less than 20 gauge steel. The front panels shall be attached with quarter turn quick open fasteners. Side panels shall be removable for access to controls and piping within the end pockets. All painted cabinet exterior panels shall be finished with a heat cured anodic acrylic power paint of the standard factory color.

C. Unit fan shall be dynamically balanced, forward curved, DWI centrifugal type constructed of galvanized steel. Motors shall be high efficiency, permanently lubricated sleeve bearing, permanent split-capacitor type with UL listed automatic reset thermal overload protection.

D. Provide primary drain pan constructed entirely of heavy gauge stainless steel. Drain pan access that requires removal of coils is not acceptable.

E. The chilled and hot water coils are on opposite sides for each Fan Coil Unit. Contractor to reference mechanical plans and note piping configurations prior to submitting.

F. Chilled and hot water coils shall have minimum 1/2-inch copper tubes, collared and corrugated aluminum fins. Minimum working pressure of 200 psig. Include manual air vent and drain valve.

G. Provide a 1-inch pleated throwaway filter.

H. Provide piping package including 2-way modulating control valve, isolation ball valves, fixed flow control device, unions and pressure-temperature ports. Piping package shall be completely factory assembled.

I. Thermostat shall be unit mounted with integral three speed fan switch.
J. Units to have internal electrical junction box suitable for single point permanent wiring connection. Provide disconnect switch at junction box.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fan coil units level and plumb.

B. Install fan coil units to comply with NFPA 90A.

C. Suspend fan coil units from structure with elastomeric hangers. Vibration isolators are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above finished floor.

E. Install new filters in each fan coil unit within two weeks after Substantial Completion.

F. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.
2. Connect piping to fan coil unit factory hydronic piping package. Install piping package if shipped loose.
3. Connect condensate drain to indirect waste.
   a. Install condensate trap of adequate depth to seal against fan pressure. Install cleanouts in piping at changes of direction.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

C. Prepare test and inspection reports.

3.3 ADJUSTING

A. Adjust initial temperature and humidity set points.
B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 23 82 19
SECTION 23 82 20 - BLOWER COIL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes blower coil units.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.

2.2 BLOWER COIL UNITS

A. Provide JCI, Trane or approved equal.

B. Fabricated of heavy gauge galvanized steel panels insulated with antimicrobial elastomeric closed cell foam insulation. Unit shall have exterior panel fabricated of not less than 18 gauge steel. The access panels shall be attached with quarter turn quick open fasteners. Panels shall be removable for access to controls and piping.

C. Unit fan shall be dynamically balanced, forward curved, DWDI centrifugal type constructed of galvanized steel. Motors shall be high efficiency, permanently lubricated sleeve bearing, permanent split-capacitor type with UL listed automatic reset thermal overload protection.

D. Provide primary drain pan constructed entirely of heavy gauge stainless steel. Drain pan access that requires removal of coils is not acceptable.

E. Chilled and hot water coils shall have minimum 1/2-inch copper tubes, collared and corrugated aluminum fins. Minimum working pressure of 200 psig. Include manual air vent and drain valve.

F. Provide a 1-inch pleated MERV 8, throwaway filter.

G. Units to have internal electrical junction box suitable for single point permanent wiring connection. Provide disconnect switch at junction box.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install blower coil units level and plumb.

B. Install blower coil units to comply with NFPA 90A.

C. Install new filters in each blower coil unit within two weeks after Substantial Completion.

D. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
   1. Install piping adjacent to machine to allow service and maintenance.
   2. Connect piping to blower coil unit factory hydronic piping package. Install piping package if shipped loose.
   3. Connect condensate drain to indirect waste.
      a. Install condensate trap of adequate depth to seal against fan pressure. Install cleanouts in piping at changes of direction.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

C. Prepare test and inspection reports.

3.3 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 23 82 20
SECTION 26 05 00 - ELECTRICAL GENERAL PROVISIONS

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Provide all materials, labor, and equipment required to furnish and install a complete electrical system as indicated on the Drawings and as specified herein.

B. Electrical work includes, but is not limited to, the following:

1. Complete distribution system for lighting and power including the electrical service and necessary feeders, panelboards, branch circuits, conduit, lighting fixtures, control switches, and receptacles.
2. Excavation, trenching, and backfilling for conduit and/or cable.
3. Grounding and lightning protection
4. Data and Telephone system raceways, boxes, floor boxes, cable trays, and bonding.
5. Power wiring for equipment furnished under Division 21, 22 and 23.
6. Fire Alarm System
7. Branch circuit wiring and wiring devices

1.2 RELATED WORK

A. The following work shall be furnished under other Divisions of these Specifications, but shall be coordinated with said Divisions by Division 26 tradesman prior to bid.

1. Flashing of conduits into roofing and outside walls.
2. Painting.
3. Cutting and patching.
4. Heating, ventilating, air conditioning, and plumbing equipment.

1.3 DEFINITIONS

A. Provide: Shall mean "furnish, install, connect, and put in good working order."

B. Wiring: Shall mean "wire and cable, installed in raceway with all required boxes, fittings, connectors, etc. completely installed."

C. Engineer: Shall mean "Engineer of Record" whose seal is affixed to the contract specifications and drawings of Division 26.

1.4 CODES AND STANDARDS

A. Comply with applicable local, state, and federal codes.
B. Electrical work shall be installed in accordance with the Drawings and Specifications, the 2011 NEC, 2012 IBC and applicable accessibility code.

C. In event of conflict between Drawings, Specifications and such codes, Engineer shall be notified in writing prior to bid. A ruling will then be made by the Engineer in writing. All work shall be installed in strict accordance with applicable codes without additional cost to Owner.

D. Contractor shall submit and/or file all necessary specifications and drawings as required by governing authorities.

1.5 SUBMITTALS

A. Provide submittals on materials and equipment identified in the Specifications and Drawings prior to manufacturer, order, or installation in accordance with Shop Drawings, Product Data, and Samples.

B. Submittals shall include but not be limited to the following:

- Lighting fixtures
- Switchgear
- Fire Alarm System
- Lightning protection
- Voice/Data cabling
- Cable Tray
- Floor boxes

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION

3.1 SITE VISIT

A. Visit job site prior to bid date to determine actual conditions under which work shall be done, to become familiar with project, and to verify total scope of work required. Failure to do so shall not constitute a reason for an extra charge.

3.2 COMMISSIONING

A. Complete testing of all lighting, wiring, generators, etc. per TBR specifications and complete the associated standard TBR/owner checklists.

END OF SECTION 26 05 00
SECTION 26 05 01 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE
   A. Qualifications of Manufacturer: All materials and equipment used in work of Division 26 shall be produced by manufacturers regularly engaged in manufacturer of similar items and with history of successful production acceptable to the Engineer. They shall be new and be UL listed and labeled or listed and labeled by other recognized testing laboratory where such label is available.
   B. Qualifications of Installers: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in necessary crafts and who are completely familiar with specified requirements and methods needed for proper performance of work of this Section.

1.2 GUARANTEE-WARRANTY
   A. Guarantee work to be free of material and workmanship defects for a period of one year, from date of final acceptance for the project. Repair and replace defective work and other work damaged thereby which becomes defective during term of Guarantee-Warranty. Furnish Owner with three written copies of Guarantee-Warranty.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS
   A. Reference in Specifications to any article, device, product, material, fixture, form and type of construction, by name, make, or catalog number shall be interpreted as established standard of quality and shall not be construed as limiting competition. Any article, device, product, material, fixture, form and type of construction which in the judgment of Engineer, expressed in writing, is equal to that specified, may be used.
   B. Substitution shall be approved by Engineer before purchase and/or installation. If unapproved materials are installed, work required to remove and replace unapproved items shall be done at the Contractor's expense.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Electrical drawings are diagrammatic and shall not be scaled for exact sizes or locations. They are not intended to disclose absolute or unconditional knowledge of actual field conditions.
   B. Equipment shall be installed according to manufacturer's recommendations.
C. Protect work and materials from damage by weather, entrance of water, and dirt. Cap conduit during installation. Avoid damage to materials and equipment in place.

D. Satisfactorily repair or remove and replace damaged work with new materials.

E. Trenching and backfilling shall comply with Site Work of these Specifications and provide sheathing, shoring, dewatering and cleaning necessary to keep trenches and their grades in proper condition for work to be carried on. Trenches shall be excavated 6" below elevation of bottom of conduit. Backfill shall be per Site Grading and Filling.

F. Failure to route conduit through building without interfering with other equipment and construction shall not constitute a reason for an extra charge. Equipment, conduit and fixtures shall fit into available space in building and shall not be introduced into building at such times and manner as to cause damage to structure. Equipment requiring services shall be readily accessible.

G. Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate electrical systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, whether exposed or concealed.
10. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
11. Install access panels or doors where units are concealed behind finished surfaces.
12. Insulate dissimilar metals so they are not installed in direct contact.

H. Conduits which pass through floor slabs (except ground floor) shall be sealed with Fire Stop Sealant. Seal around conduits or other wiring materials passing through partitions, floors, and fire rated walls. Use UL approved Fire Stop Sealant as detailed on the drawings.
I. Coordinate electrical power connection requirements with all equipment suppliers. Where power requirements differ from drawing design requirements, Engineer shall be notified for clarification and installation requirements prior to installing that portion of work. Cost for equipment and labor for improperly installed electrical connections not coordinated and approved by other trades and the Engineer shall be incurred by the Electrical Contractor and shall not constitute a reason for an extra charge because of rework.

3.2 CUTTING AND PATCHING
   A. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

3.3 TESTING AND EQUIPMENT SERVICING
   A. Entire installation shall be free from improper grounds and short or open circuits. Conductors shall be tested before energizing circuit. Test to insure that entire system is in proper operating condition, and that adjustments and settings of circuit breakers, fuses, control equipment, and apparatus have been made. Correct defects discovered during tests.

3.4 REMOVAL OF DEBRIS
   A. Remove surplus materials and debris caused by, or incidental to electrical work. Remove such debris at frequent intervals. Keep job site clean during construction.

3.5 IDENTIFICATION OF EQUIPMENT
   A. Equipment shall be identified in accordance with Section 26.05.53, "Electrical Identification."

3.6 AS-BUILT DRAWINGS
   A. Maintain one set of blue line electrical prints on site, marked to show as-built conditions and installations, prints to be turned over to Owner after job is complete.

3.7 TEMPORARY LIGHTING AND POWER
   A. Provide, maintain and remove after construction is completed, temporary lighting adequate for workman safety and temporary power for all trades including any 1 phase power required.

3.8 POWER OUTAGES
   A. Coordinate all power outages with Owner and submit for approval proposed schedule of work indicating extent, number, and length of outages required to perform work. Contractor shall include in bid cost of overtime labor required for power outage to occur after Owner's normal hours of operation.
3.9 OTHER MATERIALS

A. Work of this Division shall also include those items not specifically mentioned or described, but which are obviously necessary to conform to the design intent, applicable codes and to produce complete electrical system that functions properly. These materials shall be as selected by Contractor but subject to approval of the Engineer.

3.10 OTHER COORDINATION

A. Contractor shall obtain and pay for all necessary permits and inspection fees required for the electrical installation.

B. Contractor shall coordinate electrical service requirements with the local electric utility company, and provide any required fee, conduit, transformer pad, metering equipment, etc. that is required.

END OF SECTION 26 05 01
SECTION 26 05 16 - CONDUIT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide a complete conduit system to support all electrical equipment and systems. Conduit system includes conduit, couplers, connectors, fittings, boxes, covers and supports.

B. No conduit serving branch circuits shall be installed in or below concrete slabs unless required for branch circuits serving loads located in the center of a room.

1.2 QUALITY ASSURANCE

A. Listing and Labeling: Provide conduit that is listed and labeled.

1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

B. Conduit and its installation shall comply with requirements of the National Electrical Code.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Electric Metallic Tubing (EMT): Allied, Wheatland, LTV Copperweld, or approved equal.

B. Rigid Metal Conduit (RMC): Allied, Wheatland, Republic, or approved equal.

C. Flexible Steel Conduit (Greenfield): Alflex, Electroflex, or approved equal.

D. Rigid Non-Metallic Conduit (PVC): Carlon Schedule 40, Cantex, Southern Pipe, Schedule 80 or approved equal.

E. Liquidtight Flexible Nonmetallic Conduit (LFNC): Alflex, Electroflex, or approved equal.

2.2 CONDUIT FITTINGS


B. Bushings: Appleton, T&B, O.Z., or Gedney

C. Straps and Hangers: Appleton, T&B, Steel City, or Minerallac.
D. Group Pipe supports: Unistrut, Kindorf, B-Line, or approved equal.

E. Expansion Fittings: O.Z. Gedney Type AX, or equal by Appleton, or approved equal.


PART 3 - EXECUTION

3.1 CONDUIT

A. In general, conduit installation shall follow layout shown on drawings. However, this layout is diagrammatic only and where changes are necessary due to structural conditions, other apparatus or other causes, such changes shall be made without cost to Owner. Offsets in conduits are not indicated and must be furnished as required.

B. Conduit shall be installed in accordance with the National Electrical Code.

C. Provide bushings on the open ends of conduit containing conductors. Insulated bushings shall be provided for conduits containing conductors #4 AWG or larger with an insulating ring an integral part of the bushing.

D. Use EMT where Drawings call for conduit to be concealed in walls or above ceilings or when cast in concrete slabs not on grade. Do not use EMT exposed lower than 4’ above floor, in wet locations, or in exterior applications.

E. Use Schedule 40 PVC encased in concrete or when installed underground. Use Schedule 80 PVC when exposed.

F. When PVC conduit is used, turn up perpendicular to slab.

G. Support conduit and secure to forms when cast in concrete so that conduit will not be displaced during pouring of concrete. Stuff boxes and cork fittings to prevent entrance of water during concrete pouring and at other times during construction, prior to completion of conduit installation.

H. Route all conduit at right angles or parallel to walls of building.

I. Use proper sized tools for bending. Do not heat metal conduit. Dents and flat spots will be rejected. Cut and thread conduit so ends will butt in couplings. Make threads no longer than necessary and ream pipe free of burrs.

J. Minimum conduit size 3/4” unless otherwise required.

K. Leave one #10 AWG or equivalent (215 lb test) nylon pull wire in empty conduits.

L. Use short pieces, approximately five (5’) feet of flexible conduit to connect motors and other devices subject to motion and vibration. Use liquid tight flexible conduit where outside or subject to water spray.
3.2 CONDUIT FITTINGS

A. When EMT is installed concealed in walls or above ceilings use steel double set screw connectors. All connectors shall have throated insulating bushing.

B. Support conduit vertically and horizontally by straps or hangers. Do not exceed intervals as described in the National Electrical Code.

C. Use expansion fittings, properly bonded to assure ground continuity, across expansion joints in floors and ceilings. Use double lock nuts and bushings on panel feeders at panel cans.

D. When connections are made to motors or other equipment, not near walls or columns, provide a vertical conduit, minimum 3/4", attached to floor with a floor flange, bring wiring out of this conduit by means of a condulet and flexible conduit extending to equipment junction box.

END OF SECTION 26 05 16
SECTION 26 05 19 - WIRE AND CABLE

PART 1 - GENERAL

1.1 WORK INCLUDED
A. Wire and cable for all service, feeders, branch circuits, and instrument and control wiring rated 600 volts and below.

1.2 QUALITY ASSURANCE
A. Listing and Labeling: Provide wire and cable that is listed and labeled.
   1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
B. Wire and cable and its installation shall comply with requirements of the National Electrical Code.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Wires and cables shall meet applicable requirements of the National Electrical Code and UL for the type of insulation, jacket, and conductor specified or indicated.
B. All conductors shall be copper with 600 volt insulation unless otherwise indicated.
C. Wire and cable shall be manufactured by Belden, General Cable, Essex, Encore, Rome Cable, Southwire, or approved equal.
D. Use solid copper type THHN/THWN for branch circuit wiring ≥ 10 AWG and smaller. No conductor for branch circuit wiring shall be smaller than ≥ 12 AWG.
E. Use stranded copper, type THHN/THWN for feeder and power circuits ≥ 8 AWG and larger.
F. Provide color coded wire and with a different color for each phase and neutral and ground as follows: 208/120 volt circuits - phases A, B, and C: black, red, and blue respectively; neutral: white; ground: green, 480/277 volt circuits – phases A, B, and C: brown, orange, and yellow, respectively, neutral: gray; ground: green. Approved color tape is acceptable for feeders. Also provide color coded wire for control circuits.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Complete conduit system before pulling any wire or cable. Use cable lubricants recommended by cable manufacturer as necessary.

B. Conductors shall be continuous from outlet to outlet or to branch circuit over-current devices. Make splices only in junction boxes. Splices shall not be made in panelboards. Control wiring shall be continuous between components and/or terminal boards.

C. A minimum of eight (8") inches of slack conductor shall be left in every outlet or junction box. There should also be enough slack so three (3") inches extends outside the outlet or junction box.

D. Make splices in conductors ≤ 10 AWG and smaller diameter with insulated, pressure-type connector. Use Scotchlok, Ideal, or equal wire connectors.

E. Make splices in conductors ≥ 8 AWG and larger diameter with solderless connectors and cover with insulation material equivalent to conductor insulation. Use Burndy compression connectors with crimpit cover, type CC, or equal.

3.2 TESTING

A. After completion of the installation and splicing and prior to energizing the conductors, wire and cable shall be given continuity and insulation tests as herein specified.

B. Test wiring to verify that no short circuits, open circuits, or accidental grounds exist. Continuity tests shall be conducted using a dc device with bell or buzzer.

C. Perform Megger tests on wiring ≥ 4 AWG and larger.

END OF SECTION 26 05 19
SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 – GENERAL

1.1 WORK INCLUDED
A. Grounding electrodes and conductors.
B. Equipment grounding conductors.
C. Bonding.
D. See Section 27 05 26 for Grounding and Bonding Requirements for Communications

1.2 PERFORMANCE REQUIREMENTS
A. The grounding system to earth resistance shall be less than 5 ohms.

1.3 QUALITY ASSURANCE
A. Listing and Labeling: Provide grounding and bonding materials that are listed and labeled.

1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

B. Components and installation shall comply with the requirements of the National Electrical Code (NEC).

C. Materials shall comply with UL 467, “Grounding and Bonding Equipment.”

PART 2 – PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers shall be Hubbell, Burndy, T&B, or approved equal.

2.2 GROUNDING ELECTRODES
A. Ground rods shall be copper clad steel with minimum dimensions of ¾ inch diameter by 10 feet long.
2.3 CONNECTORS
   A. Exothermic welded connections shall be provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.
   B. Pressure connectors shall be high-conductivity-plated units.
   C. Bolted clamps shall be heavy-duty units listed for the application.

2.4 WIRE AND CABLE
   A. All grounding conductors shall be copper.
   B. The grounding electrode conductor shall be stranded.
   C. Equipment grounding conductors shall have green insulation.
   D. Bare copper conductors shall conform to the following:
      1. Solid conductors: ASTM B-3
      2. Assembly of stranded conductors: ASTM B-8
      3. Tinned Conductors: ASTM B-33

2.5 MISCELLANEOUS CONDUCTORS
   A. Ground bus shall be bare annealed copper bars.
   B. Braided bonding jumpers shall be copper tape, braided number 30 gauge bare copper wire, and terminated with copper ferrules.
   C. Bonding strap conductor/connectors shall be soft copper, 0.05 inch thick and two (2") inches wide, unless otherwise noted.

PART 3 – EXECUTION

3.1 INSTALLATION
   A. Grounding system shall be in accordance with Article 250 of the NEC except where the Drawings or Specifications exceed NEC requirements.
   B. Install code size green grounding conductors in all feeder and branch circuits. Bond conductors to chassis or fixed equipment.
   C. All grounding conductors shall be bonded to multi-terminal ground bus at panelboard or other distribution equipment. Grouping of grounding conductors under a single lug is not acceptable.
D. Bond interior metal piping systems and metal air ducts to equipment ground conductors of pumps, fans, electric heaters, and air cleaners serving individual systems.

E. Bond structural steel and reinforcing steel in foundation footing to grounding electrode conductor. Bond steel together. Every corner column and every other column in between shall be connected to the ground ring.

F. Install a triad of ground rods, 15’ apart at the concessions stands, pressbox, fieldhouse and hospitality building. Provide a single ground rod at all ancillary buildings (ticket booths, etc). All grounding electrode connections shall be made by minimum 2/0, or larger where required by NEC 250.

G. Locate all grounding attachments away from areas subject to physical damage. Provide protective covering as required.

H. All separate grounding electrodes shall be bonded together to limit potential differences between them and between their associated wiring systems. This includes the power system, TVSS, telephone system, and system grounding electrodes.

3.2 CONNECTIONS

A. Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

   1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.
   2. Make connections with clean bare metal at points of contact.
   3. Aluminum to steel connections shall be with stainless steel separators and mechanical clamps.
   4. Aluminum to galvanized steel connections shall be with tin-plated copper jumpers and mechanical clamps.
   5. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.

B. Use exothermic welded connections for connections to structural steel and for underground connections. Comply with manufacturer's written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. For compression-type connections, use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

D. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.
E. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.

F. Where insulated ground conductors are connected to ground rods or ground buses, insulate the entire area of the connection and seal against moisture penetration of the insulation and cable.

G. Do not use flexible metal conduit and fittings as a grounding means. Pull a green wire in each piece of flexible conduit, and screw to conduit system with lugs at both ends.

3.3 FIELD QUALITY CONTROL

A. Use the fall-of-potential method as described in IEEE Standard 81 to measure the resistance of the following. Record the measurements and provide to the Engineer.

1. The resistance between earth and each ground rod prior to interconnection with other ground rods.

2. The resistance between earth and the counterpoise.

3. The resistance of the grounding system at the grounding electrode connection to earth.

   a. Measure the ground resistance when there has been no precipitation for 5 days, without the soil being moistened by any means other than natural precipitation or natural drainage or seepage, and without chemical treatment or other artificial means of reducing natural ground resistance.

4. Resistance shall be less than 5 ohms.

B. Perform continuity tests at all power receptacles to ensure the ground terminals are properly grounded to the facility ground network.

END OF SECTION 26 05 26
SECTION 26 05 29 - SUPPORTING DEVICES

PART 1 – GENERAL

1.1 WORK INCLUDED

A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fasteners.

B. See Section 27 05 29 for Cable Basket Tray and Ladder Rack installation requirements.

1.2 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with the National Electrical Code.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, Slotted Metal Angle and U-Channel Systems shall be provided by Allied Tube & Conduit, American Electric, B-Line Systems, Inc., Unistrut Diversified Products, or approved equal.

B. Subject to compliance with requirements, Conduit Sealing Bushings shall be provided by Bridgeport Fittings, Inc., Cooper Industries, Inc., Killark Electric Mfg. Co., O-Z/Gedney, Raco, Inc., Spring City Electrical Mfg. Co., Thomas & Betts Corp., or approved equal.

2.2 COATINGS

A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be aluminum or hot-dip galvanized.

2.3 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Raceways shall be supported with clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

B. Fasteners: Types, materials, and construction features as follows:

1. Expansion Anchors: Carbon steel wedge or sleeve type.
2. Toggle Bolts: All steel springhead type.

C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

D. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.

E. U-Channel Systems: 16-gauge steel channels, with 9/16-inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacturer.

2.4 FABRICATED SUPPORTING DEVICES

A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

C. Pipe Sleeves: Provide pipe sleeves of one of the following:

1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted:
   a. 3-inch and smaller: 20-gauge.
   b. 4-inch to 6-inch: 16-gauge.
   c. over 6-inch: 14-gauge.

2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with the building structural system and with other electrical installation.
C. Raceway Supports: Comply with the NEC and the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.
2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs., provide additional strength until there is a minimum of 200 lbs. safety allowance in the strength of each support.
3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
4. Support parallel runs of horizontal raceways together on trapeze-type hangers.
5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
6. Space supports for raceway types not covered by the above in accordance with NEC.
7. Support exposed and concealed raceway within 1 foot of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.
8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.

D. Vertical Conductor Supports: Install simultaneously with installation of conductors.

E. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

F. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.

G. Sleeves: Install in concrete slabs and walls and all other fire rated floors and walls for raceways and cable installations. For sleeves through fire rated wall or floor construction, apply UL listed firestopping sealant in gaps between sleeves and enclosed conduits and cables in accordance with manufacturer’s recommendations.

H. Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.
I. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:

1. Fasten by means of wood screws or screw-type nails on wood; toggle bolts on hollow masonry units; concrete inserts or expansion bolts on concrete or solid masonry; and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.

3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

END OF SECTION 26 05 29
SECTION 26 05 33 - OUTLET AND JUNCTION BOXES

PART 1 – GENERAL

1.1 WORK INCLUDED
   A. Wall and ceiling outlet boxes.
   B. Pull and junction boxes.

1.2 QUALITY ASSURANCE
   A. Listing and Labeling: Provide outlet and junction boxes that are listed and labeled.
      1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.
      2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
   B. Outlet and junction boxes and their installation shall comply with the requirements of the National Electrical Code.

PART 2 – PRODUCTS

2.1 OUTLET AND JUNCTION BOXES
   A. Outlet and junction boxes shall be galvanized steel, 1-1/2" deep minimum by Raco, T&B/Steel City, Crouse Hinds or approved equal.
   B. Boxes for interior areas with exposed conduit shall be pressed steel and in exterior areas with exposed conduit shall be cast metal with threaded hubs, "FS" type. Use galvanized steel for concealed boxes.
   C. Floor boxes for slab on grade concrete and elevated floor poke-thru type shall be combination power, communications, and AV capable; Hubbell System One Series. See plans for specific model numbers.

PART 3 – EXECUTION

3.1 GENERAL
   A. Outlet and junction boxes in inaccessible ceiling areas shall be located no more than 6 inches from ceiling access panel or from removable recessed luminaire.
   B. Install boxes to preserve fire resistance rating of partitions and other elements, using UL listed fire stop materials and methods.
C. Do not install flush mounted boxes back-to-back in walls; provide minimum six (6") inches separation. Provide minimum twenty-four (24") inches separation in fire rated walls.

D. Do not fasten boxes to ceiling support wires.

E. Support boxes independently of conduit.

F. Bonding jumpers shall be used around knockouts.

3.2 OUTLET BOXES

A. Outlet boxes shall be securely anchored, set true, and plumb and no part of box shall extend beyond finished wall or ceiling. Flush mounted boxes shall be set to within 1/8" of finished wall and a plaster ring used to make cover flush with wall.

B. Select boxes according to intended use and type of outlet. Ceiling outlet boxes shall be four (4") inches octagon and 2-1/2" deep. Use four (4") inches square boxes where required. All ceiling outlet boxes shall have a fixture stud of the no bolt, self-locking type if required to hang the fixture specified at the outlet.

C. Receptacle and switch boxes installed in concrete block walls not plastered shall be Steel City, Appleton, Raco Series No. 690 through No. 699, or approved equal masonry boxes of proper depth and gang required and specifically designed for this purpose. If more than two conduits enter box from one direction, 4" square boxes with square-cut device covers not less than one (1") inch deep specifically designed for this purpose, shall be used. Round edge plaster rings will not be acceptable for block walls. Sectional or gangable type outlet boxes will not be acceptable except in drywall construction.

D. Mount outlet boxes worked to nearest block course. Confirm ADA compliance.

E. Install blank device plates on outlet boxes left for future use.

F. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices. Confirm accessibility code compliance.

3.3 JUNCTION BOXES

A. Pull and junction boxes shall be sized in accordance with the National Electrical Code according to number of conductors in box or type of service to be provided. Minimum size is 4-11/16" square and 2-1/2" deep.

B. Pull boxes shall be provided where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with bends exceeding 270 degrees shall have a pull box installed at a convenient intermediate location.

C. Install in locations as shown on Drawings and as required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements.

D. Install pull and junction boxes above accessible ceilings and in unfinished areas only.
3.4 ADJUSTING
   A. Adjust flush-mounting outlets to make front flush with finished wall material.
   B. Install knockout closures in unused box openings.

3.5 CLEANING
   A. Clean interior of boxes to remove dust, debris, and other material.
   B. Clean exposed surfaces and restore finish.

END OF SECTION 26 05 33
SECTION 26 05 53 - ELECTRICAL IDENTIFICATION

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Extent and types of electrical identification are indicated herein and as follows:

1. Operational instructions and warnings.
2. Danger signs.
3. Equipment/system identification signs.
5. Power and control wiring identification.
6. Terminal marking.
7. Arc-flash warning.
8. Panelboard Legends.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, identification products shall be provided by W.H. Brady Co., Ideal Industries, Inc., Panduit, T&B, or approved equal.

2.2 MATERIALS

A. General: Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

B. Cable/Conductor Identification Bands: Provide manufacturer's standard wrap-around type, vinyl-cloth, self-adhesive cable/conductor markers with either pre-numbered plastic coated type or write-on type with clear plastic self-adhesive cover flap, numbered to show circuit identification. Provide markers for all field control wiring.

C. Self-Adhesive Plastic Signs: Provide manufacturer's standard, self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings. Signs shall be of sizes suitable for application areas and adequate for visibility, with proper wording for each application (as examples: 208V, EXHAUST FAN or DANGER – HIGH VOLTAGE).

1. Colors: Unless otherwise indicated or required by governing regulations, provide orange signs with black lettering.
D. Engraved Plastic-Laminate Signs: Provide three-layer engraving stock in sizes and thickness indicated, engraved with engraver's standard letter style of sizes and wording indicated, black and white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

1. Thickness: 1/16", for units up to 20 sq. in. or eight (8") length; 1/8" for larger units.
2. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

E. Underground Warning Tape: Provide four (4") inch wide detectable type, plastic, yellow warning tape with suitable warning describing type of cable/circuit over buried electrical lines.

2.3 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations, and other designations used in electrical identification work, with corresponding designations shown, specified, or scheduled. Provide numbers, lettering, and working as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of electrical systems and equipment.

PART 3 – EXECUTION

3.1 APPLICATION AND INSTALLATION

A. General Installation Requirements:

1. Coordination: Where identification is to be applied to surfaces, which require finish, install identification after completion of painting.
2. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.
3. Conduit Identification: Where electrical conduit is exposed in spaces with exposed mechanical piping which is identified by a color-coded method, apply color-coded identification on electrical conduit in a manner similar to piping identification. Except as otherwise indicated, use orange as coded color for conduit.
4. Equipment/System Identifications: Install engraved plastic-laminate sign on each disconnect and control cabinets. Except as otherwise indicated, provide single line of text, 1/2" high lettering on 1-1/2" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide identification and warning signs for each unit of the following categories of electrical work.
   a. Electrical cabinets and enclosures.
   b. Panelboards
   c. Access panel/doors to electrical cabinets.
   d. Control stations.
   e. Disconnect switches.
B. Install signs at locations indicated or, where not otherwise indicated, at locations for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with stainless steel tamperproof fasteners.

C. Install danger signs on all disconnect and control cabinet exteriors.

D. Install danger and notice to disconnect power before removing or opening on all inner panels.

E. Install underground warning tape in accordance with the National Electrical Code.

END OF SECTION 26 05 53
SECTION 26 05 73 - OVERCURRENT PROTECTIVE DEVICES

PART 1 – GENERAL

1.1 WORK INCLUDED

A. This section includes circuit breakers and fuses.

1.2 SUBMITTALS

A. Provide manufacturer's product data for the following:
   1. Circuit breakers
   2. Enclosures
   3. Fuses (Provide complete list of all fuses and the equipment where they are used.)
   4. Shunt trips

B. Provide maintenance data for products for inclusion in the Operating and Maintenance Manual.
   1. Include a load current and overload relay heater list complied by Contractor after motors have been installed. Arrange list to demonstrate selection of heaters to suit actual motor nameplate full load currents.

1.3 QUALITY ASSURANCE

A. Listing and Labeling: Provide overcurrent protective devices that are listed and labeled.
   1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

B. Overcurrent protective devices and their installation shall comply with the requirements of the National Electrical Code.

C. Circuit breakers shall comply with UL 489, NEMA AB 1, and NEMA AB 3.

D. Fuses shall conform to NEMA FU 1.
PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Circuit Breakers: Subject to compliance with requirements, provide products by Cutler-Hammer; General Electric Co.; Siemens Energy & Automation, Inc.; Square D Co.; or approved equal.

B. Fuses: Subject to compliance with requirements, provide products by Bussmann Mfg. Co., Littlefuse Co, Ferraz Shawmut, or approved equal.

2.2 MOLDED-CASE CIRCUIT BREAKERS

A. Circuit breakers shall be bolt-on only. Plug-in type circuit breakers are not permitted.

B. Circuit breakers shall be molded case, manually operated, trip-free, with inverse-time, thermal-overload protection, and instantaneous magnetic, short-circuit protection, as required. Circuit breakers shall be completely enclosed in a molded case, with the calibrated sensing element factory-sealed to prevent tampering.

C. Thermal-magnetic tripping elements shall be located in each pole of the circuit breaker and shall provide inverse-time-delay thermal overload protection and instantaneous magnetic short-circuit protection. On frame sizes larger than 100 amperes, the instantaneous magnetic tripping element shall be adjustable and accessible from the front of the breaker.

D. Breaker size shall be as required for the continuous current rating of the circuit. Breaker class shall be as required.

E. Interrupting capacity of the branch circuit breakers shall be sufficient to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Circuit breaker minimum interrupting capacities shall be as shown on drawings and shall conform to NEMA AB 3.

F. Multipole circuit breakers shall be of the common-trip type having a single operating handle and shall have a two-position on/off indication. Circuit breakers shall have temperature compensation for operation in an ambient temperature of 104 degrees F. Circuit breakers shall have root mean square (rms) symmetrical interrupting rating sufficient to protect the circuit being supplied. Interrupting ratings may have selective type tripping (time delay, magnetic, thermal, or ground fault).

G. Breaker body shall be of phenolic composition. Breakers shall be capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required.

H. Provide UL listed service entrance equipment when used for service disconnect.

I. Circuit breakers used for switching high intensity discharge lights or fluorescent lights shall be rated for that type of service.
2.3 ENCLOSED MOLDED-CASE CIRCUIT BREAKERS
A. Enclosed circuit breakers shall be thermal-magnetic, molded-case circuit breakers in surface-mounted, nonventilated enclosures, conforming to the appropriate articles of NEMA 250 and NEMA AB 1.

2.4 FUSES
A. A complete set of fuses for all switches shall be provided. Fuses shall have a voltage rating not less than the circuit voltage.
B. Provide Class RK5 fuses for motor branch circuits.
C. Fuses shall be labeled showing UL class, interrupting rating, and time-delay characteristics, when applicable.
D. Fuse holders field-mounted in a cabinet or box shall be porcelain. Field installation of fuse holders made of such materials as ebony asbestos, Bakelite, or pressed fiber shall not be used.
E. Provide a minimum of three (3) spare fuses of each size and type fuse installed.
F. Provide a complete list of all fuses and the equipment where they are used.

2.5 EQUIPMENT ENCLOSURES
A. Enclosures for equipment shall be in accordance with NEMA 250.
B. Equipment installed inside, clean, dry locations shall be contained in NEMA Type 1, general-purpose sheet-steel enclosures.
C. Equipment installed in wet locations shall be contained in NEMA Type 3R, rainproof, sheet-steel enclosures, constructed for outdoor use to protect against falling rain, sleet, and ice.
D. Ferrous-metal surfaces of electrical enclosures shall be cleaned, phosphatized, and painted with the manufacturer’s standard finish.

PART 3 – EXECUTION

3.1 INSTALLATION
A. Install overcurrent protective devices as indicated or required, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements.
B. Coordinate with other work, including electrical wiring work, as necessary to interface installation of overcurrent protective devices. C. Fasten circuit breakers without mechanical stresses, twisting or misalignment being exerted by clamps, supports, or cables.
D. Install enclosed circuit breakers plumb with operating handle at five (5') feet above finished elevation.

E. Set field-adjustable circuit breakers for trip settings as indicated, subsequent to installation of devices.

F. Provide engraved plastic-laminate identification under the provisions of Section 26.05.53, "Electrical Identification" for enclosed circuit breakers and motor controllers.

3.2 FIELD QUALITY CONTROL

A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and for short-circuits. Correct malfunctioning units, and then demonstrate compliance with requirements.

B. In the presence of the Owner or Owner’s Representative, test each device and demonstrate its working as specified.

END OF SECTION 26 05 73
SECTION 26 08 00 – ELECTRICAL & LIGHTING SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification Section 01 91 13 – Commissioning

C. Specification Section 22 08 00 – Plumbing Systems Commissioning

D. Specification Section 23 08 00 – Mechanical & Controls Systems Commissioning

E. Specification Section 26 08 06 – Panelboard Check Sheet

F. Specification Section 26 08 13 – Power Circuit Check Sheet

G. Specification Section 26 08 50 – Lighting Check Sheet

H. Commissioning Plan (to be provided in Construction Phase containing process workflows, communication protocols, project-specific equipment checklists and project-specific functional performance test procedures)

1.2 COMMISSIONED SYSTEMS

A. The following systems, equipment and their components are included in the scope of the commissioning activities and are considered to be commissioned systems and equipment.

1. Pad Mounted Liquid Filled Medium Voltage Transformers

2. Medium Voltage Pad Mounted Switchgear

3. Dry-Type Transformers

4. Switchboards

5. Panelboards

6. Disconnect Switches

7. Lightning Protection

8. Transient Voltage Surge Suppressors

9. Interior Lighting Systems and Controls
10. Fire Alarm System

1.3 RESPONSIBILITIES

A. The Contractor shall be responsible for adhering to applicable code required procedures, standards and industry practices to ensure personal safety, the safety of others, and facility safety with regard to electrical equipment operation and testing. If there are procedures in the checklists or the functional performance tests which conflict with safety, the Contractor shall not proceed and shall notify the CxA immediately.

PART 2 - PRODUCTS

2.1 MEANS OF ACCESS

A. The Contractor shall provide means for the CxA to access, observe and visually confirm proper operation of all equipment and systems. These means shall be in compliance with all OSHA and job-site safety regulations.

2.2 TEST EQUIPMENT

A. The Contractor shall provide the necessary equipment to fully test the commissioned systems as defined in the functional performance test procedures to be provided by the CxA.

B. The test equipment shall meet the following minimum requirements.

1. All test equipment shall be in good mechanical and electrical condition.

2. Field test metering used to check power system meter calibration will be more accurate than the instrument being tested.

3. Accuracy of metering in test equipment shall be appropriate for the test being performed.

4. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and the tested equipment.

C. Calibration

1. Calibration of all test equipment shall be current.

2. Calibration accuracy shall be traceable to National Institute of Standards and Technology (NIST).

3. Test equipment shall be calibrated in accordance with the following schedule.

   a. Field instruments
      1) Analog – At least every 6 months
      2) Digital – At least every 12 months

   b. Leased Specialty Equipment – At least every 12 months
4. Dated calibration labels shall be visible on all test equipment.

5. Calibration records shall be provided for all test equipment used in the project.

PART 3 EXECUTION

3.1 EQUIPMENT RECEIPT INSPECTION CHECKLISTS

A. Equipment receipt inspection checklists, provided by the CxA, shall be completed by the Contractor online using CxAlloy TQ commissioning software. Free access to the software will be provided by the CxA to the Contractor's personnel.

3.2 EQUIPMENT PRE-FUNCTIONAL CHECKLISTS

A. Equipment pre-functional checklists, provided by the CxA, shall be completed by the Contractor online using CxAlloy TQ commissioning software. Free access to the software will be provided by the CxA to the Contractor's personnel.

3.3 PANELBOARD CHECK SHEET

A. The Contractor shall check and record voltage and current readings on the Panelboard Check Sheet.

1. Voltage and Amperage readings off by 5% between phases shall be investigated and a variance of 10% indicated there is a problem.

B. The Contractor shall check the Ground for leakage current.

1. Ground current of less than 1 amp is acceptable.

2. Ground current of 1 to 3 amps shall be checked.

3. Ground current of more than 3 amps indicates a problem.

C. The Contractor shall check and record the Main breaker settings, Long Term, Short Term, Instantaneous and Ground Fault. The Contractor shall provide this information to the Electrical Designer to verify that they are correct.

1. NOTE: VFDs will cause noise on neutral and ground and fluctuations on voltage as SCRs fire. They also induce motor bearing currents and shaft voltages that will cause pitting of the shaft and motor failure. If none of the following shaft voltage/current eliminators are utilized on the motors, the motors should be checked for excessive voltage/current to determine if a retrofit is required.

3.4 POWER CIRCUIT CHECK SHEET

A. The Contractor shall test receptacle circuits for voltage drop, impedance on hot leg and GFI/ARC, at the
last receptacle on the branch line. Record findings on the Power Circuit Check Sheet

1. Circuits used for computers or voltage sensitive equipment, at design amperage, must not be less than 6% and for all other circuits less than 10% of design.

2. At all times the load voltage should not drop below 111 volts.

3.5 LIGHTING CHECK SHEET

A. The Contractor shall demonstrate lighting levels at desk level after dark to ensure that they are not affected by outside light and record readings on the Lighting Check Sheet

3.6 START-UP PLAN

A. The Contractor shall perform start-up testing for each piece of equipment to ensure that the equipment and systems are properly installed and ready for operation, so that functional performance testing may proceed without delays.

B. The Contractor shall prepare a start-up plan for each piece of equipment. This plan shall be submitted to the CxA for review and comment. The start-up plan shall consist, at a minimum of the following:

1. The manufacturer’s standard start-up and check out procedures copied from the installation manuals.

2. Checklists and procedures with specific spaces for recording and documenting the inspection of each procedure and a summary block for deficiencies and explanations.

C. Two (2) weeks prior to expected start-up for a piece of equipment, the Contractor shall notify the Owner and the CxA in writing. The execution of the start-up plan shall be directed and performed by the Contractor. The CxA and/or the Owner may be present for the start-up of the first unit of each type of equipment.

D. The Contractor shall submit the completed equipment checklists to the CxA for review. The Contractor shall note all non-compliance items on these checklists. The Contractor shall notify the CxA when outstanding items have been corrected.

E. The Contractor shall complete the start-up plan and resolve or correct all issues resolved before functional testing may begin.

3.7 FUNCTIONAL PERFORMANCE TESTS

A. The Contractor shall provide all documentation as requested to the CxA for development of functional performance testing procedures. This documentation shall include, at a minimum, manufacturer installation, start-up, operation and maintenance procedures. The CxA may request further documentation as necessary for the development of functional performance tests.

B. Functional performance tests shall be performed on all of the commissioned systems and equipment.
C. The Contractor shall review the functional performance test procedures developed by the CxA.
   1. The Contractor shall respond in writing to the CxA regarding the acceptability of the proposed test procedures.
   2. The Contractor shall note any necessary modifications to the procedures due to the actual equipment/systems or safety concerns and shall submit these to the CxA for consideration.

E. The Contractor shall place equipment and systems into operation and continue the operation as required during each working day of the testing activities.

F. The Contractor shall accomplish the functional performance testing of equipment based on procedures developed by the CxA and as reviewed by the Contractor.
   1. The Contractor shall provide skilled technicians to operate the systems during functional performance testing. At a minimum, the contractor should provide one trade technician familiar with the system being tested and one controls technician to operate the system through the BAS.
   2. The Contractor shall correct any deficiencies identified during testing and retest equipment as required.

G. Functional performance testing is intended to begin upon completion of a system. Functional performance testing may proceed prior to the completion of the system at the discretion of the CxA and the Contractor.

H. Functional testing shall verify all sequences of operation defined in the Contract Documents for the commissioned equipment and systems.
   1. Testing shall occur by overriding setpoints or sensor readings at the BACS or by other means mutually agreed to by the Contractor, the CxA, and the Owner to initiate sequences of operation and verifying the response of the system.
   2. Sequences of operation shall be verified under normal power, emergency power, and fire alarm scenarios.

I. Upon successful completion of all functional performance tests, the Contractor(s) shall perform Integrated Systems Testing. The testing shall document and verify the proper response of all Division 23 systems to all potential utility and emergency power operating and failure scenarios.

END OF SECTION 26 08 00
# PANELBOARD CHECK SHEET

**Owner's Project Number:** 166/

**Institution or Campus:** 

**Building:** 

**Installer:** 

**System/Unit Identifier:** 

**Location:** 

## ITEM

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**SECTION 26 08 13**

**POWER CIRCUIT CHECK SHEET**

Owner's Project Number: 166/

Institution or Campus:

Building:

Installer:

System/Unit Identifier:

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Power Circuit Check Sheet

26 08 13 - 1

Posted in XLS format
June 2011 OFD s260813
Page 1 of 1
# LIGHTING CHECK SHEET

**Owner's Project Number:** 166/

**Institution or Campus:**

**Building:**

**Installer:**

**System/Unit Identifier:**

**Location:**

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*June 2011 OFD s260850*

*Page 1 of 1*
SECTION 26 12 19 – PAD MOUNTED LIQUID FILLED MEDIUM VOLTAGE TRANSFORMERS

PART 1 – GENERAL

1.1. DESCRIPTION

A. This specification covers the electrical and mechanical characteristics of 45-10,000 kVA Three-Phase Step-Down Pad-Mounted Distribution Transformers.

1.2. APPLICABLE STANDARDS

A. All characteristics, definitions, and terminology, except as specifically covered in this specification, shall be in accordance with the latest revision of the following ANSI®, IEEE®, NEMA®, and Department of Energy standards.


PART 2 – PRODUCTS

2.1 TRANSFORMER CONSTRUCTION

A. The transformer shall be designed in accordance with this specification and the kVA rating shall be 1000 to 1500kVA as shown on drawings. Acceptable manufacturers include Eaton/Cooper, Howard Industries, Square-D/Schneider, General Electric, and Siemens.

B. The primary voltage, configuration, and the basic lightning impulse insulation level (BIL) shall be 12470GrdY/7200 at 95kV BIL.

C. The secondary voltage, configuration, and the basic insulation level (BIL) of the secondary voltage shall be 480Y/277 at 30kV BIL.

1. For complete connector rating, see IEEE Std 386™-2006 standard.
2. Transformers are suitable for connectors with phase-to-ground or phase-to-ground/phase-to-phase high-voltage ratings as listed.
3. Arrester coordination may require higher BIL on multiple connections than indicated to achieve a minimum protection level of 20kV.

D. The transformer may be furnished with full capacity high-voltage taps. The tap changer shall be clearly labeled to reflect that the transformer must be de-energized before operating the tap changer as required in Section 4.3 of IEEE Std C57.12.34™-2009 standard. The tap changer shall be operable on the higher voltage only for transformers with dual voltage primaries. The unit shall have one of the following tap configurations:

1. Four – 2 2/3% taps below rated voltage (four below)

E. The average winding temperature rise above ambient temperature, when tested at the base transformer rating, shall not exceed 55 °C, and when tested at 112% of the base rating, shall not exceed 65 °C.

F. The percent impedance voltage, as measured on the rated voltage connection, shall be per Table 2. For target impedances, the tolerance on the impedance shall be ± 7.5% of nominal value for impedance values greater than 2.5%. The tolerance on the impedance shall be ± 10.0% for impedance values less than or equal to 2.5%.

<table>
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<tr>
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<tr>
<td>75</td>
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<td>112.5-300</td>
<td>1.40 - 5.75</td>
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<tr>
<td>500</td>
<td>1.70 - 5.75</td>
</tr>
<tr>
<td>750-3750</td>
<td>nominal</td>
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G. The core and coil shall be vacuum processed to ensure maximum penetration of insulating fluid into the coil insulation system. While under vacuum, the windings will be energized to heat the coils and drive out moisture, and the transformer will be filled with preheated filtered degassed insulating fluid. The core shall be manufactured from burr-free, grain-oriented silicon steel and shall be precisely stacked to eliminate gaps in the corner joints. The coil shall be insulated with B-stage, epoxy coated, diamond pattern, insulating paper, which shall be thermally cured under pressure to ensure proper bonding of conductor and paper. Coils shall be either aluminum or copper (eliminate a metal if one is required over the other).

H. The dielectric coolant shall be listed less-flammable fluid meeting the requirements of National Electrical Code Section 450-23 and the requirements of the National Electrical Safety Code (IEEE Std C2™-2002 standard), Section 15. The dielectric coolant shall be non-toxic, non-bioaccumulating and be readily and completely biodegradable per EPA OPPTS 835.3100. The base fluid shall be 100% derived from edible seed oils and food grade performance enhancing additives. The fluid shall not require genetically altered seeds for its base oil. The fluid shall result in zero mortality when tested on trout fry. The fluid shall be certified to comply with the US EPA Environmental Technology Verification (ETV) requirements, and tested for compatibility with transformer components. The fluid shall be Factory Mutual Approved, UL Classified Dielectric Medium (UL-EOUV) and UL Classified Transformer Fluid (UL-EOVK), Envirotemp FR3™ fluid.

I. The high-voltage and low-voltage compartments, separated by a metal barrier, shall be located side-by-side on one side of the transformer tank. When viewed from the front, the low-voltage compartment shall be on the right. Each compartment shall have a door that is constructed so as to provide access to the high-voltage compartment only after the door to the low-voltage compartment has been opened. There shall be one or more additional fastening devices that must be removed before the high-voltage door can be opened. Where the low-voltage compartment door is of a flat panel design, the compartment door shall have three-point latching with a handle provided for a locking device. Hinge pins and associated barrels shall be constructed of corrosion-resistant material, passivated ANSI Type 304 or the equivalent.

1. A recessed, captive, penta-head or hex-head bolt that meets the dimensions per IEEE Std C57.12.28™-2014 standard shall secure all access doors.
2. The compartment depth shall be in accordance with IEEE Std C57.12.34™-2009 standard, unless additional depth is specified.
3. The tank base must be designed to allow skidding or rolling in any direction. Lifting provisions shall consist of four lifting lugs welded to the tank.
4. The tank shall be constructed to withstand 7 psi without permanent deformation, and 15 psi without rupture. The tank shall include a 15 psig pressure relief valve with a flow rate of minimum 35 SCFM.
5. The exterior of the unit shall be painted Munsell 7GY3.29/1.5 green (STD), ANSI 70 gray, or ANSI 61 gray in color. If a special paint color is specified, a federal spec number or paint chip must be provided at the time of order. The cabinet interior and front plate shall be painted gray for ease of viewing the inside compartment.
6. The tank shall be complete with an anodized aluminum laser engraved nameplate. This nameplate shall meet Nameplate B per IEEE Std C57.12.00™-2010 standard. High Voltage Bushings and Terminals.
7. High voltage bushings will be installed in the high voltage termination compartment located on the front left of the transformer and requiring access via the low voltage termination compartment on the front right.

J. The high voltage bushings shall be 15/25 kV 200A bushing wells with bushing well inserts installed. The bushings shall be externally removable and be supplied with a removable stud (Re: Catalog Data CA800016EN, 500-12, and 500-26).
K. The transformer shall be provided with six (6) high voltage bushings in accordance Figure 2 dimensions (Figure 5a dimensions may be specified when a larger termination compartment for greater working space is desired) of IEEE Std C57.12.34™-2009 standard for loop feed configurations. The bushing heights shall be in accordance with Figure 3 minimum dimensions (Figure 6 dimensions may be specified for greater bushing height) of IEEE Std C57.12.34™-2009 standard.

L. The transformer shall be provided with tin-plated spade-type bushings for vertical takeoff. The spacing of the connection holes shall be 1.75" on center, per IEEE Std C57.12.34™-2009 standard Figure 13a. The quantity of connection holes per bushing shall be 12 holes. Bushing supports shall be provided for transformers requiring 10 or more connection holes. Bushing supports shall be affixed to the cabinet sidewalls; tank-mounted supports mountings are not acceptable.

M. The transformer shall be provided with bushings in a staggered arrangement in accordance with Figure 11a dimensions (Figure 12a dimensions may be specified when a larger termination compartment for greater working space is desired) of IEEE Std C57.12.34™-2009 standard.

N. The primary switching scheme provided with the transformer shall be one on-off-ground under-oil load-break switch.

O. The high-voltage overcurrent protection scheme provided with the transformer shall be an externally removable loadbreak expulsion Bay-O-Net fuse assembly with a flapper valve to minimize oil spillage. The bayonet fuses shall be in series with ELSP under-oil partial-range current-limiting back-up fuses with an interrupting rating of 50,000 A.

P. Externally mounted, Distribution Class M.O.V.E. Dead-front elbow arresters shall be supplied. (Re: Catalog Data 235-65.) M.O.V.E. arresters are for installation on 200 A rated dead-front bushing interfaces only.

Q. The high voltage switch shall be located on the exterior tank wall on the high voltage side of the transformer and shall include a viewing window that provides visible confirmation of the switch blade position. The switch shall be of a 3-position, on/off/ground configuration and shall be operable without exposure to any live circuits. Hinged covers with padlock provisions shall be provided over the window and over the switch handle. Properly sized current-limiting fuses shall be included in the transformer for additional safety.

R. For additional safety and ease of maintenance, the following instrumentation devices shall be located on the front of the external load break switch compartment: liquid level gauge, dial-type thermometer, pressure/vacuum gauge, pressure relief valve and ½" fluid sampling valve. These devices shall be protected by a hinged cover with padlock provisions.

S. The tank coating shall meet all requirements in IEEE Std C57.12.28™-2014 standard including:

1. Salt Spray
2. Crosshatch adhesion
3. Humidity
4. Impact
5. Oil resistance
6. Ultraviolet accelerated weathering
7. Abrasion resistance – taber abraser

T. The enclosure integrity of the tank and cabinet shall meet the requirements for tamper resistance set forth in IEEE Std C57.12.28™-2014 standard including but not limited to the pry test, pull test, and wire probe test.
U. All units shall be tested for the following:

1. No-Load (85 °C or 20 °C) losses at rated current
2. Total (85 °C) losses at rated current
3. Percent Impedance (85 °C) at rated current
4. Excitation current (100% voltage) test
5. Winding resistance measurement tests
6. Ratio tests using all tap settings
7. Polarity and phase relation tests
8. Induced potential tests
9. Full wave and reduced wave impulse test

V. Transformers shall conform to efficiency levels for liquid immersed distribution transformers, as specified in the Department of Energy ruling “10 CFR Part 431 Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule; April 18, 2013.” Manufacturer shall comply with the intent of all regulations set forth in noted ruling.

W. In addition, the manufacturer shall provide certification upon request for all design and other tests listed in IEEE Std C57.12.00™-2010 standard, including verification that the design has passed short circuit criteria per IEEE Std C57.12.00™-2010 standard and IEEE Std C57.12.90™-2010 standard.

X. In the event of proposal bid evaluated with guaranteed losses due to a loss evaluation (see section 10.0), manufacturer shall conform to guaranteed average losses as specified in IEEE Std C57.12.00™-2010 standard. The no-load losses of a transformer shall not exceed the specified no-load losses by more than 10%, and the total losses of a transformer shall not exceed the specified total losses by more than 6%.

PART 3 – EXECUTION

3.1 OPTIONS

A. The following accessories and options shall be provided:

1. 1.0" drain valve w/ sampling device in LV compartment
2. Automatic pressure relief valve
3. Metal drip shield
5. Meet NEMA® TR-1 sound levels
6. Liquid level gauge
7. Dial-type thermometer gauge
8. 24" deep cabinet
9. Spare bayonet fuse links
10. Ground connectors
11. Danger high voltage warning signs
12. Non-PCB decal
13. Combination UL® Listed & Classified transformer (to comply with NEC® 450-23 listing restrictions for installations on, near, or inside of buildings) per UL XPLH
3.2 SUBMITTALS

A. The following data shall be submitted for review by the engineer:

1. Core losses (when requested per Sections 7.4 and 10.0).
2. Winding losses (when requested per Sections 7.4 and 10.0).
3. Percent Impedance
4. Approval drawing – drawings shall show final dimensions and features.

3.3 INSTALLATION

A. The manufacturer of the transformer shall have regional service centers located within two (2) hours flight time of all contiguous 48 states. Service personnel shall be factory trained in commissioning and routine service of quoted transformers.

B. Transformer shall be installed per manufacturers recommended instructions on a 12” deep x 96” square concrete pad with #5 re-bar installed 12” o.c., both ways in two layers. Provide windows in concrete pad to match primary and secondary wells of the transformer.

END OF SECTION 26 12 19
SECTION 26 13 00 – MEDIUM VOLTAGE PAD MOUNTED SWITCHGEAR

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor shall furnish and install, where indicated, a free-standing, medium voltage, pad mounted switchgear. The switchgear shall be in accordance with the single-line diagram, and shall conform to the following specification.

B. The switchgear shall consist of a gas-tight tank containing SF6 gas, load-interrupter switches and resettable fault interrupters with visible open gaps and integral visible grounds, and a microprocessor-based overcurrent control. Load-interrupter switch terminals shall be equipped with bushings rated 600 amperes continuous, and fault-interrupter terminals shall be equipped with bushing wells rated 200 amperes continuous to provide for elbow connection. Manual operating mechanisms and viewing windows shall be located on the opposite side of the tank from the bushings and bushing wells, so that operating personnel shall not be required to perform any routine operations in close proximity to high-voltage elbows and cables.

1.2 RATINGS

A. The ratings for the integrated switchgear shall be as designated below.

1. Frequency, 60Hz
2. Short-Circuit Current, 12,500 Amperes, RMS, Symmetrical
3. Voltage Class, 15.5kV
4. Maximum Voltage, 15.5kV
5. BIL Voltage, 95kV
6. Main Bus Continuous Current, 600 Amperes
7. Three-Pole Load-Interrupter Switches
   a. Continuous Current, 600 Amperes
   b. Load Dropping Current, 600 Amperes
   c. Fault Closing Current, Duty-Cycle
8. Three-Time, 12,500 Amperes, RMS, Symmetrical
9. Three-Time, 32,500 Amperes, Peak
10. Ten-Time, 12,500 Amperes, RMS, Symmetrical
11. Ten-Time, 32,500 Amperes, Peak
12. Fault Interrupters
   a. Continuous Current, 200 Amperes
   b. Load Dropping Current, 200 Amperes
   c. Fault Interrupting Current, Duty-Cycle
13. Three-Time, 12,500 Amperes, RMS, Symmetrical
14. Ten-Time, 12,500 Amperes, RMS, Symmetrical
   a. Fault Closing Current, Duty-Cycle
15. Three-Time, 12,500 Amperes, RMS, Symmetrical
16. Three-Time, 32,000 Amperes, Peak
17. Ten-Time, 12,500 Amperes, RMS, Symmetrical
18. Ten-Time, 32,500 Amperes, Peak

B. The manufacturer of the switchgear shall be completely and solely responsible for the performance of the
   load-interrupter switch and fault interrupter as well as the complete integrated assembly as rated.

C. The manufacturer shall furnish, upon request, certification of ratings of the load-interrupter switch, fault
   interrupter, and the integrated switchgear assembly consisting of switches and fault interrupters in
   combination with the gas-tight tank.

1.3 COMPLIANCE WITH STANDARDS AND CODES

A. The switchgear shall conform to or exceed the applicable requirements of the following standards and
   codes:

1. The applicable portions of ANSI C57.12.28, covering enclosure integrity for pad-mounted
   equipment.
2. The applicable portions of ANSI C37.71, ANSI C37.72, ANSI C37.73, IEC 56, and IEC 265-1
   (Class A), which specify test procedures and sequences for the load-interrupter switches, fault
   interrupters, and the complete switchgear assembly.

PART 2 – PRODUCTS

2.1 SF6 GAS INSULATION

A. The SF6 gas shall conform to ASTM D2472.
B. The switchgear shall be filled with SF6 gas to a pressure of 7 psig at 68° F.
C. The gas-tight tank shall be evacuated prior to filling with SF6 gas to minimize moisture in the tank.
D. The switchgear shall withstand system voltage at a gas pressure of 0 psig at 68° F.
E. A gas-fill valve shall be provided.
F. A temperature-compensated pressure gauge shall be provided that is color coded to show the operating
   range. The gauge shall be mounted inside the gas-tight tank (visible through a large viewing window) to
   provide consistent pressure readings regardless of the temperature or altitude at the installation site.
2.2 GAS TIGHT TANK

A. The tank shall be submersible and able to withstand up to 10 feet of water over the base.

B. The tank shall be of welded construction and shall be made of 7-gauge mild steel or Type 304L stainless steel, as specified in Section 4.0.

C. A means of lifting the tank shall be provided.

2.3 GAS-TIGHT TANK FINISH

A. To remove oils and dirt, to form a chemically and anodically neutral conversion coating to improve the finish-to-metal bond, and to retard underfilm propagation of corrosion, mild-steel surfaces shall undergo a thorough pretreatment process comprised of a fully automated system of cleaning, rinsing, phosphatizing, sealing, drying, and cooling, before any protective coatings are applied. By utilizing an automated pretreatment process, the mild-steel surfaces of the gas-tight tank shall receive a highly consistent thorough treatment, eliminating fluctuations in reaction time, reaction temperature, and chemical concentrations.

B. After pretreatment, protective coatings shall be applied that shall help resist corrosion and protect the mild-steel surfaces of the gas-tight tank. To establish the capability to resist corrosion and protect the mild steel, representative test specimens coated by the manufacturer's finishing system shall satisfactorily pass the following tests:

1. 1500 hours of exposure to salt-spray testing per ASTM B 117 with:
   a. Underfilm corrosion not to extend more than 1/32 in. from the scribe, as evaluated per ASTM D 1645, Procedure A, Method 2 (scraping); and
   b. Loss of adhesion from bare metal not to extend more than 1/8 in. from the scribe.

2. 1000 hours of humidity testing per ASTM D 4585 using the Cleveland Condensing Type Humidity Cabinet, with no blistering as evaluated per ASTM D 714.

3. Crosshatch-adhesion testing per ASTM D 3359 Method B, with no loss of finish.

4. Certified test abstracts substantiating the above capabilities shall be furnished upon request.

5. The finish shall be inspected for scuffs and scratches. Blemishes shall be touched up by hand to restore the protective integrity of the finish.

6. The finish shall be indoor light gray, satisfying the requirements of ANSI Standard Z55.1 for No. 61.

2.3 VIEWING WINDOWS

A. Each load-interrupter switch shall be provided with a large viewing window at least 6 inches by 12 inches to allow visual verification of the switch-blade position (closed, open, and grounded) while shining a flashlight on the blades.

B. Each fault interrupter shall be provided with a large viewing window at least 6 inches by 12 inches to allow visual verification of the disconnect-blade position (closed, open, and grounded) while shining a flashlight on the blades.
2.4 HIGH VOLTAGE BUS

A. Bus and interconnections shall withstand the stresses associated with short-circuit currents up through the maximum rating of the switchgear.

B. Before installation of aluminum bus, all electrical contact surfaces shall first be prepared by machine-abrading to remove any oxide film. Immediately after this operation, the electrical contact surfaces shall be coated with a uniform coating of an oxide inhibitor and sealant.

2.5 PROVISIONS FOR GROUNDING

A. One ground-connection pad shall be provided on the gas-tight tank of the switchgear.

B. The ground-connection pad shall be constructed of stainless steel and welded to the gas-tight tank, and shall have a short-circuit rating equal to that of the switchgear.

C. When an enclosure is provided, no less than one enclosure ground pad shall be provided.

D. One ground-connection pad per way shall be provided.

2.6 CONNECTIONS

A. For gear rated 12.5 kA short circuit, load-interrupter switches shall be equipped with 600-ampere bushings, and fault interrupters shall be equipped with 200-ampere bushing wells.

B. Bushings and bushing wells shall be located on one side of the gear to reduce the required operating clearance.

C. Fault interrupters shall be equipped with 600-ampere bushings.

D. Load-interrupter switches shall be equipped with 200-ampere bushings.

E. Bushings and bushing wells shall conform to ANSI/IEEE Standard 386.

F. Bushings and bushing wells shall include a semiconductive coating.

G. Bushings and bushing wells shall be mounted in such a way that the semiconductive coating is solidly grounded to the gas-tight tank.
2.7 LOAD-INTERRUPTER SWITCHES

A. The three-phase, group-operated load-interrupter switches shall have a three-time and ten-time duty-cycle fault-closing rating as specified under "Ratings." This rating defines the ability to close the switch the designated number of times against a three-phase fault with asymmetrical (peak) current in at least one phase equal to the rated value, with the switch remaining operable and able to carry and interrupt rated current. Certified test abstracts establishing such ratings shall be furnished upon request.

B. The switch shall be provided with an integral ground position that is readily visible through the viewing window to eliminate the need for cable handling and exposure to high voltage to ground the equipment.

C. The ground position shall have a three-time and ten-time duty-cycle fault-closing rating.

D. The switch shall be provided with an open position that is readily visible through the viewing window to eliminate the need for cable handling and exposure to high voltage to establish a visible gap.

E. The open gaps of the switch shall be sized to allow cable testing through a feedthru bushing or the back of the elbow.

2.8 FAULT INTERRUPTERS

A. Fault interrupters shall have a three-time and ten-time duty-cycle fault-closing and fault interrupting rating as specified under "Ratings." This rating defines the fault interrupter's ability to close the designated number of times against a three-phase fault with asymmetrical (peak) current in at least one phase equal to the rated value and clear the resulting fault current, with the interrupter remaining operable and able to carry and interrupt rated current. Certified test abstracts establishing such ratings shall be furnished upon request.

B. The fault interrupter shall be provided with a disconnect with an integral ground position that is readily visible through the viewing window to eliminate the need for cable handling and exposure to high voltage to ground the equipment.

C. The ground position shall have a three-time and ten-time duty-cycle fault-closing rating.

D. A disconnect shall be provided with an open position that is readily visible through the viewing window, eliminating the need for cable handling and exposure to high voltage to establish a visible gap.

E. The fault interrupter, including its three-position disconnect, shall be a single integrated design so that operation between the closed and open positions or the open and grounded positions is accomplished with a single, intuitive movement.

F. The open gaps of the disconnect shall be sized to allow cable testing through a feedthru bushing or the back of the elbow.

G. An internal indicator shall be provided for each fault interrupter to show when it is in the tripped condition. The indicator shall be clearly visible through the viewing window.
2.9 OPERATING MECHANISMS

A. Load-interrupter switches and fault interrupters shall be operated by means of a quick-make, quick-break mechanism.

B. The manual handle shall charge the operating mechanism for closing, opening, and grounding of the switches and fault interrupters.

C. A single, integrated operating mechanism shall fully operate each fault interrupter or load interrupter switch in a continuous movement, so that additional operations are not required to establish open or grounded positions.

D. Operating mechanisms shall be equipped with an operation selector to prevent inadvertent operation from the closed position directly to the grounded position, or from the grounded position directly to the closed position. The operation selector shall require physical movement to the proper position to permit the next operation.

E. Operating shafts shall be pad-lockable in any position to prevent operation.

F. The operation selector shall be pad-lockable to prevent operation to the grounded position.

G. The operating mechanism shall indicate switch position which shall be clearly visible from the normal operating position.

2.10 OVERCURRENT CONTROL

A. A microprocessor-based overcurrent control shall be provided to initiate fault interruption.

B. For dry-vault-mounted style and pad-mounted style switchgear, the control shall be mounted in a watertight enclosure. For UnderCover style and wet-vault-mounted style switchgear, the control shall be mounted in a submersible enclosure. The control shall be removable in the field without taking the gear out of service.

C. Control settings shall be field-programmable using a personal computer connected via a data port to the control. The data port shall be accessible from the exterior of the enclosure. Neither external power nor energization of the gear shall be required to set or alter control settings.

D. Power and sensing for the control shall be supplied by integral current transformers.

E. The minimum total clearing time (from initiation of the fault to total clearing) for fault interruption shall be 40 milliseconds (2.4 cycles) at 60 hertz or 44 milliseconds (2.2 cycles) at 50 hertz.

G. The standard E-speed curve shall have phase-overcurrent settings ranging from 25E through 400E. The standard K-speed curve shall have phase-overcurrent settings ranging from 25K through 200K. The coordinating-speed tap curve shall have phase-overcurrent and independent ground-overcurrent settings ranging from 50 amperes through 400 amperes. The coordinating-speed main curve shall have phase-overcurrent settings ranging from 100 amperes through 800 amperes and independent ground-overcurrent settings ranging from 100 amperes through 400 amperes.


I. The control shall have field-adjustable instantaneous-trip settings (0.2 kA through 6 kA) and definite-time delay settings (32 ms through 96 ms for coordinating-speed tap and 64 ms through 128 ms for coordinating-speed main), to allow tailoring of the coordinating-speed tap and coordinating-speed main curves to the application.

J. Event records shall be easily extractable from the control using a personal computer connected to the data port.

2.11 VOLTAGE INDICATION

A. Voltage indication shall be provided for each load-interrupter switch and fault interrupter by means of capacitive taps on the bushings, eliminating the need for cable handling and exposure to high voltage to test the cables for voltage prior to grounding. This feature shall include a flashing liquid-crystal display to indicate the presence of voltage for each phase, and a solar panel to supply power for testing of the complete voltage-indication circuit.

B. The voltage-indication feature shall be mounted on the covers for the viewing windows, on the opposite side of the gear from the bushings and bushing wells, so that operating personnel shall not be required to perform any routine operations in close proximity to high-voltage elbows and cables.

2.12 PAD-MOUNTED SWITCHGEAR STYLE

A. The gas-tight tank shall be made of 7-gauge mild-steel.

B. For gear rated 12.5 kA short circuit, the switchgear shall conform to or exceed the requirements of applicable portions of IEC 298, Appendix AA covering arc resistance, through 12.5 kA for 15 cycles.

C. Enclosure

1. The switchgear shall be provided with a pad-mounted enclosure suitable for installation of the gear on a concrete pad.

2. The pad-mounted enclosure shall be separable from the switchgear to allow clear access to the bushings and bushing wells for cable termination.

3. The basic material shall be 14-gauge hot-rolled, pickled and oiled steel sheet.
4. The enclosure shall be provided with removable front and back panels, and hinged lift-up roof sections for access to the operating and termination compartments. Each roof section shall have a retainer to hold it in the open position.

5. Lift-up roof sections shall overlap the panels and shall have provisions for pad-locking that incorporate a means to protect the padlock shackle from tampering.

6. The base shall consist of continuous 90-degree flanges, turned inward and welded at the corners, for bolting to the concrete pad.

7. Panel openings shall have 90-degree flanges, facing outward, that shall provide strength and rigidity as well as deep overlapping between panels and panel openings to guard against water entry.

8. For bushings rated 600 amperes continuous, the termination compartment shall be of an adequate depth to accommodate encapsulated surge arresters mounted on 600-ampere elbows having 200-ampere interfaces.

   a. For bushing wells rated 200 amperes continuous, the termination compartment shall be of an adequate depth to accommodate 200-ampere elbows mounted on feedthru inserts.
   b. An instruction manual holder shall be provided.
   c. Non-removable lifting tabs shall be provided.

9. Enclosure Finish

   a. All exterior welded seams shall be filled and sanded smooth for neat appearance.
   b. To remove oils and dirt, to form a chemically and anodically neutral conversion coating to improve the finish-to-metal bond, and to retard underfilm propagation of corrosion, all surfaces shall undergo a thorough pretreatment process comprised of a fully automated system of cleaning, rinsing, phosphatizing, sealing, drying, and cooling, before any protective coatings are applied. By utilizing an automated pretreatment process, the enclosure shall receive a highly consistent thorough treatment, eliminating fluctuations in reaction time, reaction temperature, and chemical concentrations.
   c. After pretreatment, protective coatings shall be applied that shall help resist corrosion and protect the steel enclosure. To establish the capability to resist corrosion and protect the enclosure, representative test specimens coated by the manufacturer's finishing system shall satisfactorily pass the following tests:

      1) 4000 hours of exposure to salt-spray testing per ASTM B 117 with:

         a) Underfilm corrosion not to extend more than 1/32 in. from the scribe, as evaluated per ASTM D 1645, Procedure A, Method 2 (scraping); and
         b) Loss of adhesion from bare metal not to extend more than 1/8 in. from the scribe.

      2) 1000 hours of humidity testing per ASTM D 4585 using the Cleveland Condensing Type Humidity Cabinet, with no blistering as evaluated per ASTM D 714.

         a) 500 hours of accelerated weathering testing per ASTM G 53 using lamp UVB-313, with no chalking as evaluated per ASTM D 659, and no more than 10% reduction of gloss as evaluated per ASTM D 523.
         b) Crosshatch-adhesion testing per ASTM D 3359 Method B, with no loss of finish.
c) 160-inch-pound impact, followed by adhesion testing per ASTM D 2794, with no chipping or cracking.
d) 3000 cycles of abrasion testing per ASTM 4060, with no penetration to the substrate.

d. Certified test abstracts substantiating the above capabilities shall be furnished upon request.
e. The finish shall be inspected for scuffs and scratches. Blemishes shall be touched up by hand to restore the protective integrity of the finish.
f. The finish shall be olive green, Munsell 7GY3.29/1.5.

2.13 LABELING

A. The exterior of the pad-mounted enclosure (if furnished) shall be provided with "Warning-Keep Out-Hazardous Voltage Inside-Can Shock, Burn, or Cause Death" signs.

B. Each unit of switchgear shall be provided with a "Danger-Hazardous Voltage-Failure to Follow These Instructions Will Likely Cause Shock, Burns, or Death" sign. The text shall further indicate that operating personnel must know and obey the employer's work rules, know the hazards involved, and use proper protective equipment and tools to work on this equipment.

C. Each unit of switchgear shall be provided with a "Danger-Keep Away-Hazardous Voltage-Will Shock, Burn, or Cause Death" sign.

D. Each unit of switchgear shall be provided with a nameplate indicating the manufacturer's name, catalog number, model number, date of manufacture, and serial number.

E. Each unit of switchgear shall be provided with a ratings label indicating the following: voltage rating; main bus continuous current rating; short-circuit rating; fault-interrupter ratings including interrupting and duty-cycle fault-closing; and load-interrupter switch ratings including duty-cycle fault-closing and short-time.

2.14 ACCESSORIES

A. A USB cable kit shall be provided for connecting an overcurrent control to a user-furnished personal computer.

PART 3 – EXECUTION

3.1 MANUFACTURER'S CERTIFICATION

A. A certified test report of all standard production tests shall be available to the Engineer upon request.

3.2 TRAINING

A. The Contractor shall provide a training session for up to five (5) owner's representatives for 1 normal workday at a job site location determined by the owner.
B. A manufacturer’s qualified representative shall conduct the training session. The training program shall consist of instruction on operation of the assembly, circuit breakers, fused switches, and major components within the assembly.

3.3 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer’s instructions, contract drawings and National Electrical Code.

B. Contractor shall provide a concrete housekeeping pad, 12" thick, sized per manufacturer’s recommendations with #5 re-bar reinforcement 12” o.c. both ways in two layers. Provide windows in the pad to match the cabling wells provided in the bottom of the switchgear. Concrete shall be 4000 psi rated.

C. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to the housekeeping. All necessary hardware to secure the assembly in place shall be provided by the Contractor

3.4 OVERCURRENT PROTECTIVE DEVICE COORDINATION ANALYSIS

A. The manufacturer shall provide an overcurrent protective device coordination analysis to verify that electrical equipment is protected against damage from short-circuit currents. Analysis results shall be used to select appropriately rated protective devices and settings that minimize the impact of short-circuits in the electrical system, by isolating faults as quickly as possible while maintaining power to the rest of the system.

B. As applicable, the analysis shall take into account pre-load and ambient-temperature adjustments to fuse minimum-melting curves, transformer magnetizing-inrush current, full-load current, hot-load and cold-load pick-up, coordination time intervals for series-connected protective devices, and the type of reclosers and their reclosing sequences. Locked-rotor motor starting curves and thermal and mechanical damage curves shall be plotted with the protective-device time-current characteristic curves, as applicable.

C. Differing per-unit fault currents on the primary and secondary sides of transformers (attributable to winding connections) shall be taken into consideration in determining the required ratings or settings of the protective devices.

D. The time separation between series-connected protective devices, including the upstream (source-side) device and largest downstream (load-side) device, shall be graphically illustrated on log-log paper of standard size. The time-current characteristics of each protective device shall be plotted such that all upstream devices shall be clearly depicted on one sheet.

E. The manufacturer shall furnish coordination curves indicating the required ratings or settings of protective devices to demonstrate, to the extent possible, selective coordination. The following information shall be presented on each coordination curve, as applicable:

1. Device identifications.
2. Voltage and current ratios.
3. Transformer through-fault withstand duration curves.
5. Cable damage curves.
6. Transformer inrush points.
7. Maximum available fault current, in kA symmetrical, on the utility source side of the incoming feeder or first upstream device.
8. Single-line diagram of the feeder branch under study.
9. A table summarizing the ratings or settings of the protective devices, including:
   a. Device identification.
   b. Relay current-transformer ratios, and tap, time-dial, and instantaneous-pickup settings.
   c. Circuit-breaker sensor ratings; long-time, short-time, and instantaneous settings; and time bands.
   d. Fuse type and rating.
   e. Ground fault pickup and time delay.

F. The manufacturer shall use commercially available PC-based computer software such as CYMTCC from CYME International and/or SKM Captor to create the time-current characteristic curves for all protective devices on each feeder.

G. The manufacturer shall perform a site walk-down to gather:
   1. Transformer ratings, including voltage, current, power, percent impedance, winding ratio, and X/R ratio, plus wiring connections.
   2. Protective device ratings, including current, time-current characteristics, settings, and time delays.
   3. Switchgear data, including conductor phase spacing, type of grounding, and appropriate working distances.

3.5 FIELD ADJUSTMENTS

A. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study.

B. Necessary field settings of devices, adjustments and minor modifications to equipment to accomplish conformance with an approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the owner.

END OF SECTION 26 13 00
SECTION 26 22 00 - DRY-TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor shall furnish and install single-phase and three-phase general purpose individually mounted dry-type transformers of the two-windings type, self-cooled as specified herein, and as shown on the contract drawings.

1.2 REFERENCES

A. The transformers and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of ANSI, NEMA and UL.

B. Transformers shall meet the requirements of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment"

1.3 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:

1. Outline dimensions and weights
2. Technical certification sheet
3. Transformer ratings including:
   a. kVA
   b. Primary and secondary voltage
   c. Taps
   d. Basic impulse level (BIL) for equipment over 600 volts
   e. Design impedance
   f. Insulation class and temperature rise
   g. Sound level.
4. Product data sheets

1.4 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes.

1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process
2. Connection diagrams
3. Installation information
4. Seismic certification and equipment anchorage details as specified
1.5 QUALIFICATIONS
   A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
   B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
   C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.6 REGULATORY REQUIREMENTS
   A. All transformers shall be UL listed and bear the UL label.

1.7 DELIVERY, STORAGE AND HANDLING
   A. Equipment shall be handled and stored in accordance with manufacturer’s instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.8 OPERATION AND MAINTENANCE MANUALS
   A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Eaton products
      The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Other manufacturers will be considered, provided their products meet the requirements of the documents.

2.2 RATINGS
   A. The kVA and voltage ratings shall be as indicated on the drawings.
   B. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96.
C. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

<table>
<thead>
<tr>
<th>Range</th>
<th>Sound Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 9 kVA</td>
<td>40 dB</td>
</tr>
<tr>
<td>10 to 50 kVA</td>
<td>45 dB</td>
</tr>
<tr>
<td>51 to 150 kVA</td>
<td>50 dB</td>
</tr>
<tr>
<td>151 to 300 kVA</td>
<td>55 dB</td>
</tr>
<tr>
<td>301 to 500 kVA</td>
<td>60 dB</td>
</tr>
<tr>
<td>501 to 700 kVA</td>
<td>62 dB</td>
</tr>
<tr>
<td>701 to 1000 kVA</td>
<td>64 dB</td>
</tr>
<tr>
<td>1001 to 1500 kVA</td>
<td>65 dB</td>
</tr>
</tbody>
</table>

2.3 CONSTRUCTION – GENERAL PURPOSE TRANSFORMERS

A. Insulation Systems

1. Transformer insulation system shall be as follows:

   a. Less than 15 kVA: 185 degrees C insulation system with 115 degree C rise, encapsulated design; 15 kVA and above: 220 degree C insulation system with 115 degree C rise, ventilated design.

2. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degrees C maximum ambient, and a 24-hour average ambient of 30 degrees C

3. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635

B. Core and Coil Assemblies

1. Transformer core shall be constructed with high-grade, nonaging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade aluminum with continuous wound construction

2. On three-phase units rated 15 kVA and below the core and coil assembly shall be completely encapsulated in a proportioned mixture of resin and aggregate to provide a moisture proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level

3. On three-phase units rated 15 kVA and above the core and coil assembly shall be impregnated with non-hydroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture. The assembly shall be installed on vibration-absorbing pads

C. Taps

1. Three-phase transformers rated 15 through 500 kVA shall be provided with six 2-1/2% taps, two above and four below rated primary voltage

2. All single-phase transformers, and three-phase transformers rated below 15 kVA and above 500 kVA, shall be provided with the manufacturer’s standard tap configuration.
D. Electrostatic Shielding

1. Where shown on the drawings, provide shielded isolation transformers with an electrostatic shield consisting of a single turn of aluminum placed between the primary and secondary winding and grounded to the housing of the transformer.

2.4 ENCLOSURE – GENERAL PURPOSE TRANSFORMERS

A. The enclosure shall be made of heavy-gauge steel. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90 degrees C. The core of the transformer shall be grounded to the enclosure.

B. On three-phase units rated 15 kVA and below, the enclosure construction shall be encapsulated, totally enclosed, non-ventilated, NEMA 3R, with lifting eyes.

C. On three-phase units rated 15 kVA and above, the enclosure construction shall be ventilated, NEMA 2, drip-proof, with lifting holes. All ventilation openings shall be protected against falling dirt.

2.5 FINISH

A. Enclosures shall be finished with ANSI 61 color, weather-resistant enamel.

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

1. Ratio tests at the rated voltage connection and at all tap connections
2. Polarity and phase relation tests on the rated voltage connection
3. Applied potential tests
4. Induced potential test
5. No-load and excitation current at rated voltage on the rated voltage connection

3.2 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer’s recommendations and the contract drawings.

3.3 FIELD ADJUSTMENTS

A. Adjust taps to deliver appropriate secondary voltage.
3.4 FIELD TESTING

A. Measure primary and secondary voltages for proper tap settings.

END OF SECTION 26 22 00
SECTION 26 24 00 - MECHANICAL EQUIPMENT AND CONTROLS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of contract, including general and supplementary conditions and general requirements apply to work specified in this section.

PART 2 – PRODUCTS

2.1 STARTERS

A. All starters for Division 22 and 23 package mechanical equipment will be furnished by Division 22 and 23, but installed and connected by Division 26.

2.2 CONTROL WIRING

A. All control wiring for mechanical equipment shall be provided in conduit under each respective division. Control components for mechanical equipment will be furnished and installed by Division 22 and 23.

2.3 POWER WIRING

A. All power wiring at 120, 208, 277 and 480 volts shall be provided by Division 26.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Coordinate electrical power connection requirements with Mechanical Contractor. Where power requirements differ from drawing design requirements, Engineer shall be notified in writing. Contractor shall be given clarification and installation requirements prior to installation of the portion of work. Cost of equipment and labor for improperly installed electrical connections not coordinated and approved by Engineer and Mechanical Contractor shall be incurred by the Electrical Contractor and shall not constitute a reason for an extra charge because of any rework.

END OF SECTION 26 24 00
SECTION 26 24 13 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor shall furnish and install, where indicated, a free-standing, dead-front type low voltage distribution switchboard, utilizing group mounted circuit protective devices as specified herein, and as shown on the contract drawings.

1.2 REFERENCES

A. The low voltage distribution switchboards and all components shall be designed, manufactured and tested in accordance with the latest applicable following standards:

1. NEMA PB-2
2. UL Standard 891

1.3 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:

1. Master drawing index
2. Front view elevation
3. Floor plan
4. Top view
5. Single line
6. Schematic diagram
7. Nameplate schedule
8. Component list
9. Conduit entry/exit locations
10. Assembly ratings including:
    a. Short-circuit rating
    b. Voltage
    c. Continuous current

11. Major component ratings including:
    a. Voltage
    b. Continuous current
    c. Interrupting ratings

12. Cable terminal sizes
13. Product data sheets
B. Where applicable, the following additional information shall be submitted to the Engineer:

1. Busway connection
2. Connection details between close-coupled assemblies
3. Composite floor plan of close-coupled assemblies
4. Key interlock scheme drawing and sequence of operations

1.4 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process
2. Wiring diagrams
3. Certified production test reports
4. Installation information
5. Seismic certification and equipment anchorage details as specified

1.5 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.

b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.

c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.6 REGULATORY REQUIREMENTS

A. The low-voltage switchboard shall be UL labeled.
1.7 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer’s instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.8 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Square-D, Eaton, Siemens, GE

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Other manufacturers will be considered, provided their products meet the requirements of the documents.

2.2 RATINGS

A. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current of 65,000 amperes symmetrical at rated voltage as shown on the drawings.

B. Voltage rating to be as indicated on the drawings.

2.3 CONSTRUCTION

A. Switchboard shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.

B. All sections of the switchboard shall be front and rear aligned with depth as shown on the drawings. All protective devices shall be group mounted. Devices shall be front removable and load connections front accessible enabling switchboard to be mounted against a wall.

C. The assembly shall be provided with adequate lifting means.

D. The switchboard shall be equal to Square-D QED2 or Eaton type Pow-R-Line C utilizing the components herein specified and as shown on the drawings.
E. The switchboard shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.

F. The switchboard shall be special “low-height” construction, not to exceed 78” in overall height.

G. Switchboard Main Breaker shall be solid-state adjustable trip type LSIG. Feeder/Branch breakers within switchboard shall be 250 ampere frame size, or larger, solid-state adjustable trip type LSI.

2.4 BUS

A. All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient.

B. Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.

C. A copper ground bus (minimum 1/4 x 2 inch) shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.

D. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

2.5 WIRING/TERMINATIONS

A. Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer’s wiring diagrams.

B. Mechanical-type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of the size as indicated on the drawings.

C. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.

D. All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

E. Provide electronic PQM metering with recording, demand, and waveform capture per ETSU standards. Metering unit shall have capability to integrate to ETSU campus wide network. Install CAT6 drop to nearest IT closet. Provide CTs with shorting block and direct voltage connections with internal OCP and disconnecting means. Unit shall be factor installed and tested, verify unit specifications with owner.
2.6 ENCLOSURES
   A. NEMA 1 Enclosure

2.7 NAMEPLATES
   A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background. Characters shall be 3/16-inch high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Furnish master nameplate giving switchboard designation, voltage ampere rating, short-circuit rating, manufacturer's name, general order number, and item number.

   B. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

2.8 FINISH
   A. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 light gray.

2.9 SURGE PROTECTIVE DEVICE
   A. Provide surge protective device as listed elsewhere in these specifications; integral or remote mount.

PART 3 - EXECUTION

3.1 FACTORY TESTING
   A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

      1. The switchboard shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchboard will be tested for operation under simulated service conditions to ensure the accuracy of the wiring and the functioning of all equipment. The main circuits shall be given a dielectric test of 2200 volts for one (1) minute between live parts and ground, and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volts for one (1) minute between live parts and ground

   B. The manufacturer shall provide three (3) certified copies of factory test reports.

3.2 MANUFACTURER'S CERTIFICATION
   A. A certified test report of all standard production tests shall be available to the Engineer upon request.
3.3 TRAINING

A. The Contractor shall provide a training session for up to five (5) owner’s representatives for 1 normal workday at a job site location determined by the owner.

B. A manufacturer’s qualified representative shall conduct the training session. The training program shall consist of instruction on operation of the assembly, circuit breakers, fused switches, and major components within the assembly.

3.4 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer’s instructions, contract drawings and National Electrical Code.

B. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to the floor without the use of floor sills provided the floor is level to 1/8 inch per 3-foot distance in any direction. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

3.5 FIELD ADJUSTMENTS

A. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study.

B. Necessary field settings of devices, adjustments and minor modifications to equipment to accomplish conformance with an approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the owner.

END OF SECTION 26 24 13
SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor shall furnish and install the panelboards as specified and as shown on the contract drawings.

1.2 REFERENCES

A. The panelboards and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA and UL as follows:

1. UL 67 – Panelboards
2. UL 50 – Cabinets and boxes
3. NEMA PB1
5. Circuit breaker – Type I class I
6. Fusible switch – Type II class I

1.3 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:

1. Breaker layout drawing with dimensions indicated and nameplate designation
2. Component list
3. Conduit entry/exit locations
4. Assembly ratings including:
   a. Short-circuit rating
   b. Voltage
   c. Continuous current
5. Cable terminal sizes
6. Product data sheets

B. Where applicable, the following additional information shall be submitted to the Engineer:

1. Key interlock scheme drawing and sequence of operations

1.4 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:
1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process.
2. Installation information
3. Seismic certification and equipment anchorage details as specified

1.5 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. Provide Seismic tested equipment as follows:
   1. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
      a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
      b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
      c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.6 REGULATORY REQUIREMENTS

A. The panelboards shall be UL labeled.

1.7 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer’s instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.8 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Square-D, Eaton, Siemens, or GE

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Other manufacturers will be considered, provided their products meet the requirements of the documents.

2.2 RATINGS

A. Panelboards rated 240 Vac or less shall have short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 10,000 amperes RMS symmetrical.

B. Panelboards rated 480 Vac shall have short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 14,000 amperes RMS symmetrical.

C. Panelboards shall be labeled with a UL short-circuit rating. When series ratings are applied with integral or remote upstream devices, a label or manual shall be provided. It shall state the conditions of the UL series ratings including:
   1. Size and type of upstream device
   2. Branch devices that can be used
   3. UL series short-circuit rating

2.3 CONSTRUCTION

A. Interiors shall be completely factory assembled. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.

B. Trims for branch circuit panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a semi flush cylinder lock and catch assembly. Door-in-door trim shall be provided. Both hinged trim and trim door shall utilize three point latching. No tools shall be required to install or remove trim. Trim shall be equipped with a door-actuated trim locking tab. Equip locking tab with provision for a screw such that removal of trim requires a tool, at the owner’s option. Installation shall be tamper resistant with no exposed hardware on the panelboard trim.

C. Distribution panelboard trims shall cover all live parts. Switching device handles shall be accessible.

D. Surface trims shall be same height and width as box. Flush trims shall overlap the box by 3/4 of an inch on all sides.

E. A directory card with a clear plastic cover shall be supplied and mounted on the inside of each door.
F. All locks shall be keyed alike.

2.4 BUS

A. Main bus bars shall be copper sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.

B. A system ground bus shall be included in all panels.

C. Full-size (100%-rated) insulated neutral bars shall be included for panelboards shown with neutral. Bus bar taps for panels with single-pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

2.5 BRANCH CIRCUIT PANELBOARDS

A. The minimum short-circuit rating for branch circuit panelboards shall be as specified herein or as indicated on the drawings. Panelboards shall be series rated. Panelboards shall be Eaton type Pow-R-Line 1a, Pow-R-Line 2a or Pow-R-Line 3a.

B. Bolt-on type, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers of the types specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.

C. Circuit breakers shall be thermal-magnetic type with common type handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100-ampere frame and through 100-ampere trip sizes shall take up the same pole spacing. Circuit breakers shall be UL listed as type SWD for lighting circuits.

1. Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.

D. Circuit breakers shall have a minimum interrupting rating of 10,000 amperes symmetrical at 240 volts, and 14,000 amperes symmetrical at 480 volts, unless otherwise noted on the drawings.

2.6 DISTRIBUTION PANELBOARDS – CIRCUIT BREAKER TYPE

A. Distribution panelboards with bolt-on devices contained therein shall have interrupting ratings as specified herein or indicated on the drawings. Panelboards shall be series rated. Panelboards shall be Square-D NF, Eaton type Pow-R-Line 3a or Pow-R-Line 4B. Panelboards shall have molded case circuit breakers as indicated below.

B. Where indicated, provide circuit breakers UL listed for application at 100% of their continuous ampere rating in their intended enclosure.

C. Provide shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings.
2.7 ENCLOSURE
   A. Enclosures shall be at least 20 inches wide made from galvanized steel. Provide minimum gutter space in accordance with the National Electrical Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.
   B. Enclosures shall be provided with blank ends.
   C. Where indicated on the drawings, branch circuit panelboards shall be column width type.

2.8 NAMEPLATES
   A. Provide an engraved nameplate for each panel section.

2.9 FINISH
   A. Surfaces of the trim assembly shall be properly cleaned, primed, and a finish coat of gray ANSI 61 paint applied.

PART 3 EXECUTION

3.1 FACTORY TESTING
   A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.2 INSTALLATION
   A. The Contractors shall install all equipment per the manufacturer’s recommendations and the contract drawings.

END OF SECTION 26 24 16
SECTION 26 27 01 - ELECTRICAL SERVICE ENTRANCE

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Service system

PART 2 – PRODUCTS

2.1 MATERIALS

A. Furnish service entrance conduit and cable and miscellaneous hardware required.

PART 3 – EXECUTION

3.1 SERVICE

A. System shall commence at existing 15kV man-hole and continue to padmounted transformer, secondary service lateral, and on through the main switchboard, feeder circuits, panelboards, and branch circuits to wiring devices, appliances, apparatus, and other utilization equipment. See drawings for more information.

B. Services shall be 480Y/277 volts, three (3) phase, four (4) wire, solidly ground wye, from padmounted transformer provided by the electrical contract or as part of the project.

C. Primary metering will be provided at the main switchboard per campus standards. Final connections at transformer secondary will be by the electrical contractor.

END OF SECTION 26 27 01
SECTION 26 27 26 - WIRING DEVICES AND PLATES

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Switches
B. Receptacles
C. Plates

1.2 QUALITY ASSURANCE

A. Listing and Labeling: Provide wiring devices and plates that are listed and labeled.
   1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

B. Wiring devices and plates and their installation shall comply with the requirements of the National Electrical Code.

PART 2 – PRODUCTS

2.1 SWITCHES

A. Switches shall be toggle, quiet-type with totally enclosed with bodies of thermoplastic and mounting strap.
B. Switches shall be rated for 20 amps, 277 volts AC. Switches shall be specification grade Hubbell, P&S, Leviton, Cooper Wiring Devices, or approved equal.

2.2 RECEPTACLES

A. Receptacles shall be general purpose, heavy duty, duplex receptacles made of thermoplastic supported on a metal mounting strap in accordance with NEMA WD 1. Receptacles shall be 20 amp, 125 volt, specification grade Cooper Wiring Devices, Hubbell, Leviton, P&S.

B. Ground fault circuit interrupter receptacles shall be the “feed-through” type rated to protect 20 amps. Receptacles shall be specification grade duplex receptacles with almond impact-resistant nylon face with test and reset buttons.
   1. 20 Amp, 125 Volt: Cooper Wiring Devices, Hubbell, Leviton, P&S, or approved equal.
2. Receptacles in public areas including corridors, commons area, conference rooms, debrief rooms, lobbies, and classrooms shall be 20 Amp, 125 Volt, USB Charging type similar to Hubbell USB20X2 with two USB Type 2.0, 3 Amp, 5VDC rated ports.

C. Special Receptacles: As indicated on Drawings.

2.3 PLATES

A. Provide UL listed, one-piece device plates to suit the devices installed.

B. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast-metal having round or beveled edges.

C. Plates on finished walls shall be nylon or thermoplastic, mid-size, unless noted otherwise. Plates in the kitchens/food service areas shall be stainless steel.

D. Plates shall be same color as receptacle or toggle switch with which they are mounted. Screws shall be machine-type with countersunk heads in color to match finish of plate.

E. Plates installed in wet locations shall be gasketed and UL listed for “wet locations” as per NEC 406.8 (B).

PART 3 – EXECUTION

3.1 INSTALLATION

A. Provide proper size outlet boxes for all wiring devices in accordance with Section 26.05.33, “Outlet and Junction Boxes.”

B. Install switches forty-eight (48") inches above finished floor on lock side and clear of door frame a minimum of three (3") inches unless otherwise noted. Prior to rough-in, coordinate with architectural drawings to determine lockside of door.

C. All switches shall be made by the same manufacturer.

D. Where two or more snap switches are to be installed at the same location, they shall be mounted in one-piece ganged switch boxes, with at gang cover plate.

E. Combination snap switch and single or duplex receptacles shall be mounted in two-gang switch box with one-piece device plate.

F. Receptacles shall be mounted 18" above finished floor unless otherwise noted.

G. All wiring devices shall be mounted in accordance with accessibility code requirements.

H. The color of all devices and plates shall be selected by the architect.

END OF SECTION 26 27 26
SECTION 26 28 13 - DISCONNECT SWITCHES

PART 1 – GENERAL

1.1 WORK INCLUDED
   A. Fused Disconnect Switches

1.2 SUBMITTALS
   A. Provide product data showing switch’s ratings and enclosure type.

1.3 QUALITY ASSURANCE
   A. Listing and Labeling: Provide disconnect switches that are listed and labeled.
      1. The term "listed and labeled": As defined in the National Electrical Code, Article 100.
      2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL)
         as defined in OSHA Regulation 1910.7.
   B. Disconnect switches and their installation shall comply with the requirements of the National Electrical Code.

PART 2 – PRODUCTS

2.1 MANUFACTURERS
   A. Switches shall be Eaton, or approved equal. Examples are Square D, General Electric, Siemens Energy & Automation.

2.2 MATERIALS
   A. Use heavy-duty type for 600 volt switches. Switches shall have quick make, quick break, load interrupter, enclosed knife switch manufactured to the requirements of NEMA KS 1.
   B. All switches shall have externally operable handles with interlocking covers to prevent opening front cover with switch in the ON position and have provisions for multiple padlocks in the OFF position.
   C. Provide equipment ground lug in each switch.
   D. Provide NEMA 1 enclosures for interior installations, unless otherwise noted.
   E. Provide NEMA 3R enclosures for exterior installations or in wet locations, unless otherwise noted.
F. Provide fuses as per equipment manufacturer recommendation.

G. Provide auxiliary contact switch (SPDT) on handle for elevator main power switch to interlock battery lowering.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Provide safety switches sized as indicated on the Drawings.

B. Mount individually enclosed switches plumb and level with top four (4') feet above floor or grade, unless otherwise noted.

C. Provide a set of fuses in fusible disconnect switches, as per equipment manufacturer recommendations.

3.2 IDENTIFICATION

A. Identify disconnect switches in accordance with Section 26.05.53, "Electrical Identification."

END OF SECTION 26 28 13
SECTION 26 41 13 - LIGHTNING PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
   A. The extent of the lightning protection work shall be as required by this section.
   B. Provide a complete master labeled lightning protection system for the building including but not limited to: air terminals, lightning conductors, and ground rods. Upon completion, deliver the U.L. Master Label Certificate to the owner.
   C. Any material and/or equipment necessary for the proper operation of the system not specified or described herein shall be deemed part of this specification.

1.2 QUALITY ASSURANCE
   A. Minimum Standards:
      1. 2008 National Electric Code
      2. NFPA 780 - Lightning Protection Code
   B. Manufacturers:
      1. Firms regularly engaged in the manufacture of lightning protection equipment, of types and sizes required whose products are in satisfactory use in similar service, such as Lightning Protection Systems of Virginia, LLC, Richmond, VA 804-230-9169, Capital Lightning Protection Company, Inc., Raleigh, N. C., 1-800-852-9590, or Maxwell Lightning Protection Company, Dayton, OH 1-800-872-1657.
   C. Submittals
      1. At time of shop drawings, submit dimensioned drawings for installation of lightning protection system for this building. Show conductor routing and accessories layout including ground rods, air terminals, splicers, fasteners, and connections.

PART 2 - PRODUCTS

2.1 COMPONENTS
   A. Provide lightning protection system components of the types, styles, which comply with manufacturers standard materials, design and construction. All conductors and air terminals shall be U.L. LISTED MATERIALS. All down conductors shall be U.L. LISTED MATERIALS. ALL MATERIALS SHALL BE SIZED AS PER U.L. 96.
PART 3 - EXECUTION

3.1 COORDINATION

A. Location of all devices and equipment shall be coordinated with the Architectural and Mechanical drawings prior to submittal of shop drawings.

3.2 INSTALLATION

A. The lightning protection system shall be installed by a specialty subcontractor whose primary business is the installation of lightning protection systems. This subcontractor should have experience in installing similar systems.

B. The lightning protection system shall be bonded to the building ground ring at required intervals. Provide a building ground ring consisting of a #4/0 bare copper loop and 10’ by 5/8” diameter ground driven rods at 50’ intervals. Ground ring shall be 3’ outside the exterior walls, installed 24” deep and bonded to the electrical service grounds. All connections shall be exothermic.

END OF SECTION 26 41 13
SECTION 26 43 13 - TRANSIENT VOLTAGE SURGE SUPPRESSORS

PART 1 – GENERAL

1.1 SUMMARY

A. This specification describes the mechanical and electrical requirements for a transient voltage surge suppressor herein known and shown on all drawings as TVSS. The TVSS shall be suitable for application in category C3 environments as described in ANSI/IEEE C62.41. The TVSS shall be parallel design and provide protection: Line to Line, Line to Neutral, Neutral to Ground. “Series” type TVSS units will be deemed unacceptable.

1.2 SUBMITTALS

A. The contractor shall submit all related TVSS specifications, electrical and mechanical drawings, maintenance manuals, and UL 1449 surge suppression ratings, as well as Independent tests performed on the TVSS that show that the TVSS being submitted is capable of controlling >104kA 8/20 surge current.

1.3 QUALITY ASSURANCE

A. Only pre-approved TVSS products shall be accepted.

B. Manufacturer Qualifications: All TVSS units shall be manufactured by a firm that has manufactured TVSS products, for at least 10 years. Firms must also regularly engage in the manufacturing of TVSS products for Categories B3 (ANSI/IEEE 62.41) and C3.

C. Codes and Standards

1. UL compliance and Labeling: Listed per UL 1449 3rd Edition.
3. NEC compliance: Comply with 2008 NEC as applicable to construction and Article 280 for installation.
4. The TVSS shall be capable of surviving 2,500 sequential category B3 and C3 surges without failure. Follow IEEE test procedures in C62.45.
5. The TVSS shall be warranted for no less than 10 years and shall include free replacement in whole or in part during that 10 years for any reason of failure.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliances with requirements, provide pre-approved product by the following:
1. Atlantic Scientific Corporation, IT Protector, Current Technology, Eaton, Square-D
2. Approved Equal.

2.2 TVSS EQUIPMENT

A. Service Entrance Suppressor:

1. The surge protection device shall be connected to a 100A overcurrent device installed in the service entrance electrical equipment with leads as short as possible and not to exceed 18 inches (ideally 10 inches).

2. The surge protection devices shall be Atlantic Scientific Corporation Model ZoneMaster Plus 300/150 Series (Part # 1810(4)XCA) or approved equal and must include the following ratings and accessories:
   a. 150kA per mode 8/20 pulse; 300kA per phase surge suppression capability.
   b. Unit shall be of modular design consisting of bolt on modules (plug in type will be unacceptable) utilizing large block 40mm MOVs. The use of multiple 20mm MOV’s in parallel will not be acceptable.
   d. A 200,000 AIC Ultra-safe fused disconnect.
   f. UL Listed 1283 Extended Power Range Filter.
   g. Multi Mode Surge counter that monitors surge current NOT voltage. Multi Mode surge counter must be able to monitor total normal mode surges, common mode, or surge currents on each individual phase.
   h. Normally Open / Normally Closed Form C Dry Contacts.
   i. Unit shall have “High Voltage” Neutral to Ground Module with Red LED indicator.
   j. Unit shall have BOTH mechanical indicator flags and green LED indicators to show status of protection for each module.
   k. All plastics shall be UL 94-5V flame class rated.
   l. Housing shall be UL listed and CSA Certified.

3. Standard unit housings shall be non-metallic and meet NEMA 1, 2, 3, 3S, 4, 4X, 12 and 13 classifications.
4. Standard unit housings shall have a transparent front cover for complete visual inspection and monitoring the status of protection for each module, and onboard diagnostics, module configuration, and wiring configuration.
5. Standard unit warranty must be for at least 10 years and be stated in the manufacturer’s literature.

B. Secondary (TVSS) Surge Suppressor:

1. The surge protection devices shall be installed as indicated on riser at 208Y120 panelboards and connected to a 50A overcurrent device installed in each of the 1st branch panelboards downstream of dry-type transformers with leads as short as possible and not to exceed 18 inches (ideally 10 inches).
2. Unit shall be UL 1449 4rd Edition listed, 50kA per mode and 100kA per phase.
3. Units shall be same manufacturer as main service TVSS unit.
PART 3 – EXECUTION

3.1 APPLICATION OF TVSS

A. General: Apply TVSS on the load side of the main disconnect at the electrical service entrance switchboard.

B. Coordinate system voltage, wiring configuration, and location as shown on project drawings.

C. Unit may be integral to switchboard or separately mounted.

3.2 INSTALLATION OF TVSS

A. Install the TVSS with #8 AWG conductors from the main service panel. The conductors are to be as short and straight as practically possible and shall not exceed 18 inches in length. The TVSS shall be installed following the manufacturer’s recommended practices and in compliance with all applicable codes.

END OF SECTION 26 43 13
SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 – GENERAL

1.1 WORK INCLUDED
A. This Section includes interior lighting fixtures, lamps, ballasts, and accessories.

1.2 DEFINITIONS
A. Fixture: A complete lighting unit. Fixtures include lamps and parts required to distribute the light, position and protect lamps, and connect lamps to the power supply.

B. Luminaire: Fixture.

C. Average Life: The published time when 50 percent have failed and 50 percent have survived under normal conditions.

1.3 SUBMITTALS
Provide the following submittals:
A. Product data describing fixtures, lamps, and ballasts. Arrange product data for fixtures in order of fixture designation.

B. Shop drawings from manufacturers detailing nonstandard fixtures and indicating dimensions, weights, methods of field assembly, components, features, and accessories.

C. Maintenance data for products for inclusion in Operating and Maintenance Manual.

D. Provide complete set of fixture information and include in O&M Manuals.

1.4 QUALITY ASSURANCE
A. Listing and Labeling: Provide fixtures, ballasts, lamps, and emergency lighting units that are listed and labeled for their indicated use on the Project.

1. Special Listing and Labeling: Provide fixtures for use in damp or wet locations and recessed in combustible construction specifically listed and labeled for such use.

2. The term "Listed and Labeled": As defined in the 2008 National Electrical Code, Article 100.

3. Listing and Labeling Agency Qualification: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
B. Interior lighting fixtures, lamps, ballasts, and accessories and their installation shall comply with the requirements of the 2008 National Electrical Code.

C. Manufacturers Qualifications: Firms experienced in manufacturing fixtures that are similar to those indicated for this Project and that have a record of successful inservice performance.

D. Coordination of Fixtures With Ceiling: Coordinate fixture mounting hardware and trim with the ceiling system.

1.5 EXTRA MATERIALS

A. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents. Deliver extra materials to the Owner.

1. Lamps and LED Boards: 1 lamps/board for each 100 of each type and rating installed. Furnish at least 1 of each type.
2. Ballasts and Drivers: 1 for each 100 of each type and rating installed. Furnish at least 1 of each type.
3. Globes and Guards: 1 for each 20 of each type and rating installed. Furnish at least 1 of each type.

PART 2 – PRODUCTS

2.1 FIXTURE COMPONENTS, GENERAL

A. Metal Parts: Free from burrs and sharp corners and edges.

B. Sheet Metal Components: Steel, except as indicated. Components are formed and supported to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating and free from light leakage under operating conditions. Arrange to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in the operating position.

D. Reflecting Surfaces: Minimum reflectances as follows, except as otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or water white, annealed crystal glass except as indicated.

1. Plastic: Highly resistance to yellowing and other changes due to aging, exposure to heat and UV radiation.
2. **Lens Thickness:** 0.125 inches, minimum.

2.2 **FLUORESCENT FIXTURES**

A. **Fixtures:** Conform to UL 1570, "Fluorescent Lighting Fixtures."

B. **Ballasts:** Conform to UL 935, "Fluorescent-Lamp Ballasts."
   1. Certification: By Electrical Testing Laboratory (ETL).
   2. Type: Class P, high-power-factory type except as indicated otherwise.
   4. Voltage: Match connected circuits.

   1. Minimum Power Factor: 90 percent.
   2. Minimum Operating Frequency: 20,000 Hz.
   3. Harmonic Content of Ballast Current: Less than 10 percent.

D. **Electromagnetic Interference Filters:** Integral to the fixture assembly. Provide one filter for each ballast. Suppress electromagnetic interference as required by MIL-STD-461, "Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference."

2.3 **LAMPS**

A. Conform to ANSI Standards, C78 series applicable to each type of lamp.

2.4 **FINISH**

A. **Steel Parts:** Manufacturer's standard finish applied over corrosion-resistant primer, free of streaks, runs, holidays, stains, blisters, and defects. Remove fixtures showing evidence of corrosion during project warranty period and replace with new fixtures.

B. **Other Parts:** Manufacturer's standard finish.

PART 3 – EXECUTION

3.1 **INSTALLATION**

A. Setting and Securing: Set units plumb, square, and level with ceiling and walls, and secure according to manufacturer's printed instructions and approved shop drawings.
B. Support For Recessed and Semirecessed Fixtures: Install fixtures so they are supported independently from the suspended ceiling support system. Install fixture support rods or wires at a minimum of four rods or wires per fixture located not more than 6 inches from fixture corners.

1. Fixtures Smaller Than Ceiling Grid: Install a minimum of four (4) rods or wires for each fixture and locate at corner of the ceiling grid where the fixture is located. Do not support fixtures by ceiling acoustical panels.
2. Fixtures of Sizes Less Than Ceiling Grid: Center in the acoustical panel. Support fixtures independently with at least two (2) 3/4-inch metal channels spanning and secured to the ceiling tees.
3. Install support clips for recessed fixtures, securely fastened to ceiling grid members, at or near each fixture corners.

C. Lamping: Lamp units according to manufacturer's instructions. Fluorescent lamps shall have minimum CRI of 82.

3.2 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Give advance notice of dates and times for field tests.

C. Provide instruments to make and record test results.

D. Tests: Verify normal operation of each fixture after fixtures have been installed and circuits have been energized with normal power source. Interrupt electrical energy to demonstrate proper operation of emergency lighting installation. Include the following in tests of emergency lighting equipment:

1. 1½ hour burn.

E. Replace or repair malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.3 ADJUSTING AND CLEANING

A. Clean fixtures upon completion of installation. Use methods and materials recommended by manufacturer.

B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION 26 51 00
SECTION 26 61 00 - GENERAL LIGHTING PROVISIONS

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Fixtures
B. Controls
C. Lamps
D. Ballasts & Drivers
E. Exterior Fixtures
F. Emergency Lighting

1.2 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 26.05.00.
B. Submit shop drawings for luminaries showing pertinent physical characteristics and performance data.
C. Submit samples of luminaries prior to final production at Engineer’s request on any proposed fixture substitution.
D. Provide a complete set of fixture information and include in O&M Manuals.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Provide fixtures as shown in the fixture schedule or approved equal.

2.2 FIXTURES

A. Provide electronic instant start ballasts in all fluorescent lighting fixtures and drivers in all LED lighting fixtures with less than 10% total harmonic distortion suitable for roof/floor or roof/ceiling fire rating indicated on architectural plans. Ballasts and drivers shall be Universal, Advance, or General Electric. Recessed lighting fixtures drivers and ballasts shall be provided with integral thermal protection.

B. Provide instant start lamps for all fluorescent fixtures. Lamps shall be General Electric and 3,500 °K, CRI of 80 or better, unless specified otherwise.
2.3 CONTROLS
   A. Time switches shall be Tork, Intermatic, or Paragon of types and quantity shown on Drawings.

2.4 EMERGENCY EGRESS LIGHTING UNITS AND EXIT SIGNS
   A. Provide fully automatic operation on power failure. Units shall have integral battery back-up for 1½ hours per NFPA. Units shall be connected unswitched to lighting circuits.

PART 3 – EXECUTION

3.1 GENERAL
   A. Furnish, locate, and install fixtures as indicated on Drawings.

3.2 INSTALLATION
   A. Mount fixtures as called for in schedule on Drawings. Determine type of ceiling to be installed in each space and furnish fixtures suitable for exact type, including roof/floor or ceiling/floor fire rated design. Recessed fixtures shall be supported from building structure.

   B. Lighting fixtures shall be structurally supported. Fluorescent fixtures mounted in the ceiling shall be attached to ceiling system as required by NEC 410-16(b). Surface mounted fixtures shall be supported from building structural system by rods or rods and clamps, or by fixture outlet box which in turn shall be supported by rods.

   C. Receive, store, uncrate, and install light fixtures shown in schedule on drawings to be specified by others.

   D. Adjust lighting fixtures to illuminate the intended area.

   E. Wire recessed fluorescent luminaries with Type THHN wire not smaller than No. 12.

   F. Wire surface mounted fluorescent luminaries with Type THHN wire not smaller than No. 12 from outlet boxes.

   G. Locate no splice or tap within an arm or stem. Wire shall be continuous from splice in outlet box of building wiring system to lamp socket or ballast terminals.

END OF SECTION 26 61 00
1.1 DESCRIPTION
   A. Telecommunications systems shall be provided as indicated on drawings and as called for hereinafter.

1.2 REFERENCE STANDARDS
   C. ANSI/NECA/BICSCI-568, Standard for Installing Commercial Building Telecommunications Cable.
   D. ANSI/TIA 569-C, Pathways and Spaces.
   E. ANSI/TIA 568-C.0, Generic Telecommunications for Customer Premises Standard Series
      568-C.1 Commercial Building Cabling
      568-C.2 Copper Cabling Components
      568-C.3 Fiber Cabling Components
      568-C.4 Coax Cabling Components
   F. ANSI/TIA 606-B, Addendum 1, Administration Standard for Commercial Telecommunications Infrastructure.
   G. ANSI J-STD-607-B, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
   H. ANSI/TIA 758-B, Customer owned Outside Plant Telecommunications Cabling Standard
   I. ANSI/TIA-526, 7&14, Telecommunications Measurements of Optical Fiber Single and Multi Mode Power Loss
   K. ANSI/TIA 310-D, Cabinets, Racks, Panels, and Associated Equipment.
   L. FCC Part 68, Connection of Terminal Equipment to the Telephone Network.
   M. ADA of 2010 and Telecommunications Act of 1996, Physically Impaired and Accessibility.
   O. IEEE 802.11ax Wireless LAN's
S. ETA Electronic Technician Association Fiber Optics Installer
T. FOA Fiber Optics Association Certified Fiber Optics Technician
U. ANSI/SCTE 77 Underground Enclosure Integrity

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 27 01 00
SECTION 27 05 26 - COMMUNICATIONS GROUNDING & BONDING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, tools, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the installation, termination, and labeling of grounding and bonding infrastructure as described on the Drawings and/or required by these specifications.

1.2 REFERENCE

B. ANSI/TIA-607-B-2011 Commercial Building Grounding and Bonding Requirements for Telecommunications
C. NFPA 70™-2011 National Electrical Code
D. NFPA 70E*-2004 Standard for Electrical Safety in the Workplace
F. UL 467 Standard for Grounding and Bonding Equipment
G. See SECTION 270100 Reference Standards
H. See SECTION 270553 Administration Labeling
I. See SECTION 270529 Hangers and supports

1.3 QUALIFICATIONS

A. Products specified in this Section shall be manufactured by a company with a minimum of three years' documented experience specializing in manufacturing such products.

1.4 DEFINITIONS

A. Backbone: A facility (e.g. pathway, cable or conductors) between telecommunications rooms, or floor distribution terminals, the entrance facilities, and the equipment rooms within or between buildings.
B. Bonding: The permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity and the capacity to conduct safely any current likely to be imposed.

C. Common Bonding Network (CBN): The principal means for effecting bonding and grounding inside a telecommunication building. It is the set of metallic components that are intentionally or incidentally interconnected to form the principal bonding network (BN) in a building. These components include structural steel or reinforcing rods, plumbing, alternating current (ac) power conduit, ac equipment grounding conductors (ACEGs), cable racks, and bonding conductors. The CBN always has a mesh topology and is connected to the grounding electrode system.

D. EMI (Electromagnetic Interference) - The interference in signal transmission or reception resulting from the radiation of electrical or magnetic fields.

E. Entrance Facility (telecommunications): An entrance to a building for both public and private network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.

F. Equipment Room (telecommunications): An centralized space for telecommunications equipment that serves the occupants of the building. An equipment room is considered distinct from a telecommunications room because of the nature or complexity of the equipment.


H. Ground: A conducting connection, whether intentional or incidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth.

I. Grounding Electrode Conductor: The conductor used to connect the grounding electrode to the equipment grounding conductor, to the grounded conductor, or to both, of the circuit at the service equipment, or at the source of a separately derived system.

J. Grounding Equalizer (GE): A bonding conductor that interconnects TGBs on the same floor, (formerly TBBIBC).

K. Mesh Bonding Network (Mesh-BN): A bonding network to which all associated equipment (e.g., cabinets, frames, racks, trays, pathways) are connected using a bonding grid, which is connected to multiple points on the common bonding network.

L. Primary Protector: A surge protective device placed on telecommunications entrance conductors in accordance with ANSI/NFPA 70 and ANSI/ATIS 0600318. and listed under ANSI/UL 497.

M. Rack Bonding Conductor (RBC): A bonding conductor used to connect the rack/cabinet directly to the TMGMB/TMB/MB

N. Room (telecommunications): An enclosed space for housing telecommunications equipment, cable terminations, and cross-connect cabling, that is the recognized location of the cross-connect between the backbone and the horizontal facilities.

O. Telecommunications Bonding Backbone (TBB): A conductor that interconnects the telecommunications main grounding busbar (TMGMB) to the telecommunications grounding busbar (TGB).
P. Telecommunications Equipment Bonding Conductor (TEBC): A conductor that connects the telecommunications main grounding busbar (TMGB) or telecommunications grounding busbar (TGB) to equipment racks or cabinets.

Q. Telecommunications Grounding Busbar (TGB): The interface to the building telecommunications grounding system generally located in telecommunications room. A common point of connection for telecommunications system and equipment bonding to ground, and located in the telecommunications room or equipment room.

R. Telecommunications Main Grounding Busbar (TMGB): A busbar placed in a convenient and accessible location and bonded, by means of the bonding conductor for telecommunications, to the building service equipment (power) ground.

S. Unit Bonding Conductor (UBC): A bonding conductor used to connect u rack/cabinet mounted equipment unit to the grounding structure (i.e., conductor, busbar) utilized in that rack/cabinet.

PART 2: PRODUCTS

2.1 CABLE

A. THHN

1. The telecommunications backbone shall be a copper conductor.
2. Shall be rated, plenum-riser, depending on the environment, or bare copper may be acceptable in approved applications.
3. Jacket color shall be green or bare copper may be acceptable in approved applications.
4. Cable size per table in Part 3

2.2 BUSBARS

A. Telecommunications Main Grounding Busbar (TMGB)

1. Pre-drilled copper with holes to accommodate lug mounting holes
2. 0.25" thick x 4" wide with varying length
3. Sized for current applications and future growth
4. Insulated from its support
5. The TMGB may use an electro-tin plated busbar
6. Maintain a 2" min clearance from wall
7. Size

   a. 4" X 16" – Copper - Hubbell Part Number HBBB14416H
   b. 4" X 16" – Tin Plated Copper- Hubbell Part Number HBBB14416HTP
   c. 4" X 20" – Copper - Hubbell Part Number HBBB14420J
   d. 4" X 20" – Tin Plated Copper- Hubbell Part Number HBBB14420JTP

B. Telecommunications Grounding Busbar (TGB)

1. Pre-drilled copper with holes to accommodate lug mounting holes
2. 0.25” thick x 2” wide with varying length
3. Sized for current applications and future growth
4. The TGB may use an electro-tin plated busbar
5. maintain a 2” min clearance from wall
6. Size & material
   a. 2” X 10” – Copper - Hubbell Part Number HBBB14210A
   b. 2” X 10” – Tin Plated Copper - Hubbell Part Number HBBB14210ATP
   c. 2” X 24” – Copper - Hubbell Part Number HBBB14224B
   d. 2” X 24” – Tin Plated Copper - Hubbell Part Number HBBB14224BTP

C. Horizontal Cabinet or Equipment Rack Busbar - 19"
   1. Mounts to standard 19” Rack or Frame
   2. Capacity: 6 Double hole lugs
   3. Size & material
      a. 0.75” x 19” x 0.25” – Copper - Hubbell Part Number HBBBHR19KT
      b. 0.75” x 19” x 0.25” – Tin Plated Copper - Hubbell Part Number HBBBHR19KTTP

D. Vertical Cabinet or Equipment Rack Busbar – 36 to 72”
   1. Mounts to vertical rail or Inside of cabinet in 19” or 23” Rack or Frame
   2. Capacity: 9 Double hole lugs
   3. Size & material
      a. 0.75” x 36” x 0.25” – Copper - Hubbell Part Number HBBBVR36KT
      b. 0.75” x 36” x 0.25” – Tin Plated Copper - Hubbell Part Number HBBBVR36KTTP

2.3 COMPRESSION LUGS
A. Shall be UL & CSA listed
B. Shall be able to accept 6 AWG to 3/0 AWG
C. Compression type
D. Two holes with various holespacing’s to fit the busbar
E. Long barrel that will allow a minimum of two crimps with standard industry colors
F. An inspection window to verify that the conductor is fully seated in the lug
G. Have a traceable feature to ensure proper die size was used to make the crimp
H. Crimped according to manufacturer’s recommendation
I. Size (XX – specify AWG)
   1. 0.250” holes X 0.625” spacing
      a. 0 degrees – Hubbell Part Number HGBLXXD
b. 45 degrees - Hubbell Part Number HGBLXXD45
c. 90 degrees – Hubbell Part Number HGBLXXD90

2. 0.250” holes x 0.750” spacing
   a. 0 degrees – Hubbell Part Number HGBLXXDA

3. 0.375” holes x 1.000” spacing
   a. 0 degrees – Hubbell Part Number HGBLXXDB
   b. 90 degrees – Hubbell Part Number HGBLXXDB90

2.4 TAPS

A. Connections to the Conductor shall be made with irreversible compression connectors

B. Shall be UL & CSA listed

C. Shall be able to accept 6 AWG to 3/0 AWG

D. Have a traceable feature to ensure proper die size was used to make the crimp

E. Requires a minimum of (2) crimps for C Tap and H Tap, 1 crimp for I-Beam and busbar Tap

F. Crimp according to manufacturer’s recommendation.

G. C Taps:
   1. Main Run 6-4AWG - Tap 6AWG
      a. Hubbell Part Number HYC4C6
   2. Main Run 6-4 AWG – Tap 4AWG
      a. Hubbell Part Number HYC4C4
   3. Main Run 2 AWG – Tap 8-4AWG
      a. Hubbell Part Number HYC2C4
   4. Main Run 2AWG – Tap 2AWG
      a. Hubbell Part Number HYC2C2
   5. Main Run 1/0-2/0AWG – Tap 8-2AWG
      a. Hubbell Part Number HYC26C2
   6. Main Run 1/0-2/0AWG – Tap 1/0-2/0AWG
      a. Hubbell Part Number HYC26C26
H. H Tap
   1. Main Run 4/0-2 AWG - Tap 2-8 AWG
      a. Hubbell Part Number HYH292C
   2. Main Run 2-8 AWG – Tap 2-8 AWG
      a. Hubbell Part Number HYH2C2C
   3. Main Run 6-10 AWG – Tap 6 AWG
      a. Hubbell Part Number HYH6C6C

I. I-Beam Tap
   1. I-Beam steel with a Standard Flange
      a. Hubbell Part Number HYGIBS
   2. I-Beam steel with a Wide Flange
      a. Hubbell Part Number HYGIBW

G. Busbar Tap
   1. Bubsar thickness 0.25”, Main Run 2 AWG - Tap 6 AWG
      a. Hubbell Part Number HYG14B2TC2C6C
   2. Bubsar thickness 0.25”, Main Run 2 AWG – Tap 2 AWG
      a. Hubbell Part Number HYG14B2TC2C2C
   3. Bubsar thickness 0.25”, Main Run 4/0 – 1/0 AWG
      a. Hubbell Part Number HYGBTC28

2.5 LADDER RACK BONDING CONDUCTORS

A. Ground cord assembly
   1. Stranded THHN
   2. Color: green
   3. #6 AWG insulated bonding jumper
   4. Length: 9” - 12”.
   5. Each end terminated with a twohole compression lug or listing approved terminal
   6. Hubbell Part Number HGRKTD12D, HGRKTKA9KA5, HGRKTKLU9KLU5
B. Braided Jumper
   1. 0.94” Braid width
   2. Hole diameter 0.375”
   3. HoleSpacing 1.25”
   4. Length: 12”
   5. Hubbell Part Number HGBBD12

2.6 BASKET TRAY CONDUCTORS
   A. Mounts to the basket tray metal runner
   B. Accepts #6 AWG cable that spans the gaps between sections of basket tray
   C. Hubbell Part Number HGBKS17, HGRKTWC45, HGRKTWB5

2.7 WRIST STRAP ESD PORT
   A. Lug w/ 4mm banana plug to attach ESD wrist strap.
   B. Two (2) hole lug
   C. Placed inside cabinet or on equipment rack
   D. Must be identifiable as an ESD connection point
   E. Hubbell Part Number HGBESDKT10

2.8 RAISED FLOOR GROUNDING CLAMP
   A. Ability to do both parallel and grid configurations
      1. HGBGX1P1828RF - Grid or Parallel
      2. HGBGP1526G1 - Parallel
      3. HGBGRF4C3 - Parallel
   B. Attached to the stringer of the raised floor
      1. HGBGX1P1828RF - 0.75”-1.5” Round or Square
      2. HGBGP1526G1 - 1.0”-1.25” Round
      3. HGBGRF4C3 - 0.75”-1.0” Round or Square
   C. Wire Range.
      1. HGBGX1P1828RF 6 – 4/0 AWG
      2. HGBGP1526G1 4 – 2/0 AWG
      3. HGBGRF4C3 8 – 2 AWG
PART 3 - EXECUTION

3.1 TELECOMMUNICATIONS MAIN GROUND BUSBAR (TMGB)

A. The TMGB shall be:

1. Pre-drilled copper with holes to accommodate lug mounting holes
2. 0.25" t x 4" w with varying length
3. Sized for current applications and future growth
4. Insulated from its support
5. Maintain a 2" min clearance from wall
6. Installed to maintain clearances required by applicable codes
7. In an accessible location
8. As close to the panelboard as practicable min 36"
   a. Where a panelboard (electrical power panel) is located in the same room or space as the TMGB that panelboard’s alternating current equipment ground (ACEG) bus (when equipped) or the panelboard enclosure shall be bonded to the TMGB.
9. Be Listed by a nationally recognized testing laboratory
10. 36" from active electronics or the panelboard

B. The TMGB should:

1. Be located in the telecommunication entrance facility
   a. The ideal location of the TMGB is in the telecommunications entrance facility.
2. Have a mounting height adjusted to accommodate overhead or underfloor cable routing.
3. Minimize the length of bonding conductor for telecommunications
4. Provide for the shortest and straightest routing of the primary
5. Be located near backbone cabling and associated terminations
6. Serve telecommunications equipment that is located within the same room or space.

C. The TMGB may use an electro-tin plated busbar

D. Attachments to TMGB

1. Bonding Conductor – Electrical Distribution Panel
2. Primary protector
3. Building Steel
4. Outside plant cables
5. Backbone cables that incorporates a shield or metallic member
6. All metallic pathways for telecommunications cabling located within the same room or space as the TMGB.
7. Cable tray
8. Ladder rack
9. Conduit
10. Telecommunications equipment located in the TEF (e.g., multiplexer or optical fiber termination equipment).
11. TBB
12. TEBC
13. Primary protector grounding conductor

   a. A minimum of 1 ft separation shall be maintained between this insulated conductor and any
dc power cables, switchboard cable, or high frequency cables, even when placed in rigid
metal conduit or EMT.

3.2 TELECOMMUNICATION GROUND BUSBAR (TGB)

A. The TGB shall:

1. Be a predrilled copper busbar provided with holes for use with standard sized lugs,
2. Have minimum dimensions of 6 mm (0.25 in) thick x 50 mm (2 in) wide and variable length to meet
the application requirements and with consideration of future growth.
3. Be insulated from its support attachment a minimum of 2”.
4. Be listed by a nationally recognized testing laboratory (NRTL).
5. Maintain 36” separation from active electronics

B. It is acceptable that the busbar be electro-tin plated for reduced contact resistance. If not plated, the
busbar shall be cleaned prior to fastening the conductors to the busbar, and an anti-oxidant should be
applied to the contact area to control corrosion and reduce contact resistance.

C. The TGB is the grounding connection point for telecommunications systems and equipment in the area
served by that telecommunications room or equipment room.

D. Where a panelboard is located in the same room or space as the TGB that panelboard’s ACEG bus (ac
electrical ground when equipped) or the panelboard enclosure shall be bonded to the TGB. When a
panelboard for telecommunications equipment is not in the same room or space as the TGB, that TGB
should be bonded to the panelboard that feeds the distributor.

E. The TBBs and other TGBs within the same space shall be bonded to the TGB with a conductor the same
size as the TBB.

F. Where a grounding equalizer (GE) is required, it shall be bonded to the TGB.

3.3 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

A. The intended function of a TBB is to reduce or equalize potential differences between telecommunications
systems. While the TBB will carry some current under ac power ground fault conditions, it is
not intended to provide the only ground fault return path.

B. The TBB shall:

1. Be connected to the TMGB & TGB.
2. Be a continuous copper conductor that should be sized no less than 6 AWG to a maximum of 3/0
   AWG. The TBB shall be sized in accordance to the conductor table. (TABLE 1)
3. Be consistent with the design of the telecommunications backbone cabling system;
4. The TBB conductors shall be installed and protected from physical and mechanical damage.
5. The TBB conductors should be installed without splices.
a. Where splices are necessary, the number of splices should be a minimum and they shall be accessible and located in telecommunications spaces.

b. Joined segments of a TBB shall be connected using exothermic welding, irreversible compression-type connectors, or equivalent.

C. Permit multiple TBBs as dictated by the building size;

D. The metallic cable shield shall not be used as a TBB.

3.4 GROUNDING EQUALIZER (GE)

A. The GE shall be a continuous copper conductor that should be sized no less than 6 AWG to a maximum of 3/0 AWG. The GE shall be sized in accordance to the conductor table. (TABLE 1)

B. The GE connects the telecommunications grounding busbar(s) in the same-floor telecommunications rooms (TRs) on the first, top, and every third floor in a multistory building.

C. Cable shields do not satisfy the requirements for a GE.

3.5 TELECOMMUNICATIONS EQUIPMENT BONDING CONDUCTOR (TEBC)

A. Connects the TMGB/TGB to equipment racks/cabinets

B. Shall be a continuous copper conductor that should be sized per the length of cable.

C. Shall be separated from ferrous materials by 2" or be bonded to the ferrous metal

1. May be routed within cable trays or suspended 2" under or off the side of the cable tray or ladder rack

D. Shall be supported every 3ft

E. 8" Bend radius – with no less than a 90 degree bend

F. May come in contact with other cable groups at a 90 degree angle only

G. Cable shields do not satisfy the requirements of a TEBC

H. There may be more than one TEBC within each telecommunication room.

3.6 RACK BONDING CONDUCTOR

A. A bonding conductor used to connect the rack/cabinet directly to the TMGB/TGB/Mesh

B. Metallic enclosures, including telecommunications cabinets and racks, shall be bonded to the mesh-BN, TGB, or TMGB using a minimum sized conductor of No. 6 AWG.

C. Cabinets, racks, and other enclosures in computer rooms shall not be bonded serially; each shall have their own dedicated bonding conductor to the mesh-BN, TGB, or TMGB.
3.7 ELECTRICAL DISTRIBUTION PANEL (EDP)
   A. When located in the same room as the TMGB/TGB the EDP’s equipment grounding bus or the panel board enclosure shall be bonded to the TMGB/TGB.
   B. Using a bonding conductor for telecommunications (BCT) minimum 6 AWG to a maximum of 3/0 AWG depending on the length of cable required.
   C. Use same AWG as TBB
   D. A qualified electrician shall make all connections within an ac electrical panel.
   E. Outside of the scope of ANSI/TIA-607B

3.8 CONDUCTIVE FIBER OPTIC CABLES
   A. The metallic components of a conductive cable are capable of transmitting current.
   B. Conductive fiber-optic cables should be bonded and grounded as specified in NEC Article 770.100

3.9 LADDER RACK AND/OR CABLE TRAY
   A. To achieve the objective of potential equalization in the TR, all cable runway sections are bonded together and bonded back to the TMGB/TGB
   B. Maintain a 8” Bend Radius on the TEBC
   C. Keep a 2” separation from other cables, power and telecommunications
   D. Remove any paint, oxidation, etc. from the runway surfaces that are being bonded
   E. Drill two holes as required to accommodate the 2-hole compression lug
   F. Apply a thin coat of antioxidant around the holes and on the surface where the lug will be in contact.
   G. Attach straps to the runway using stainless steel hardware sized for the lug holes.
   H. Tighten the hardware
   I. Wipe off any excess antioxidant after installation of the lug.

3.10 LABELING
   A. The format for the telecommunications main grounding busbar shall be FS-TMGB, while the format for the TGBs shall be FS-TGB.
      1. FS is the TS identifier for the space containing the busbar; Floor & space
      2. TMGB is the portion of an identifier designating a telecommunications main grounding busbar;
      3. TGB is the portion of the identifier designating a telecommunications grounding busbar.
B. Each telecommunications space or room shall be assigned an identifier unique within the building. The TS shall be labeled with the TS identifier inside the room so as to be visible to someone working in that room. The TS identifier shall have a format of FS.

C. All busbars and cables will have the label in Illustration 2 attached, and it will be visible and readable.

3.11 TESTING

A. Earth ground resistance tester
   1. The earth ground resistance tester generates a specific test current: this current is less susceptible to the influences of stray currents on the grounding system. This makes the ground resistance tester a more accurate testing devise that a standard Volt-Ohm-multimeter.

B. Two-point ground continuity testing
   1. Maximum value 100 milliohms

C. Follow manufacture instructions on setup and how to perform the test.

D. Care should be taken and safety precautions in place

END OF SECTION 27 05 26
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<th>Size (AWG)</th>
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Table 1

**Illustration 1**

**Proper Tap**

**Tap**

**Main**

8" Bend Radius

TO TMGB OR TGB
SECTION 27 05 29 - HANGERS AND SUPPORT

PART 1 - GENERAL

1.1 SCOPE OF WORK
   A. Furnish and install a system of cabling supports above ceilings for network, voice, and CATV cabling as set forth hereinafter.

1.2 REFERENCE STANDARDS
   A. See SECTION 27.01.00 REFERENCE STANDARDS
   B. See SECTION 27.11.13 Communications Grounding and Bonding
   C. See ETSU ITS Design and Installation Standards Policy – current version

PART 2 - PRODUCTS

2.1 BASKET TRAY
   A. All wire trays are to be UL classified.
   B. All wire tray shall be approved for grounding.
   C. All wire tray shall be approved for installations in overhead or under-floor applications.
   D. All wire tray shall have shaped cross members to reduce cable strain.
   E. All wire tray shall be 100% recycled steel content.
   F. Manufacture: Hubbell Pre-Galvanized HBT series (size dependant)

2.2 LADDER TRAY
   A. Material: 16 ga. tubular steel.
   B. Durable powder coat.
   C. Stringer dimensions: 0.375"W x 1.5"H.
   D. Rung spacing: 9.0".
   E. Weight capacity: 45 lbs./foot.
F. Manufacturer: Hubbell HLS series

1. Use 18 inch wide in all entrance and telecommunications rooms.
2. Use other sizes as needed in corridors (size dependant).

2.3 J-HOOKS

A. J-Hooks are not to be used except when no basket tray or ladder tray can be used.

B. J-Hooks are to be used in CAT5E installations. Use appropriate size J-Hooks with a maximum of 40 CAT5E cables in any J-Hook, regardless of the J-Hook’s manufacturer’s specifications.

C. When there are more than 40 CAT5E cables, ladder tray, wire basket or multiple J-Hook paths are required.

D. Non-Metallic J-Hooks for CAT6 is limited to maximum of 10 cables. All cables (CAT5E, CAT6, Coax) must be secured every 4'-5', anchor J-hooks to studs.

E. Steel J-hooks shall not be used.

F. J-hooks shall be as follows: Use Non-Metallic J-hooks, Panduit J-Pro JP75W-L20 for Cat 6 and Cooper B-line BVH32 or Erico CAT425 for Cat 5e.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Entire installation shall be in accordance with manufacturer’s recommendations.

B. Provide two separate sets of low-voltage cabling supports along entire length of low-voltage cabling runs above ceiling. One set of supports shall be of Category 6 network wiring. The second set of supports shall be for CATV wiring. Locate supports well clear of acoustical lay-in ceiling tiles. Supports shall be located such that tiles can be removed without interfering with support system.

C. Coordinate installation of low-voltage supports with other trades as required.

D. All trays shall be bonded and grounded to the telecommunications grounding system per SECTION27.11.13 Communications Grounding and Bonding.

END OF SECTION 27 05 29
SECTION 27 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATION SYSTEMS-OSP

PART 1 - GENERAL

1.1 DESCRIPTION
A. Furnish and install telecommunications outside plant (OSP) facilities as indicated on drawings and set forth hereinafter.

1.2 REFERENCE STANDARDS
A. See section 27.01.00 REFERENCE STANDARDS.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Inner Duct: MaxCell 3x3 (MXD3456), locatable for OSP, with color ID.
C. Phone Cable: 50 pair PE89 BSW (Buried Service Wire) Phone Cable-as manufactured by Essex or General Cable.
D. Handholes – Quazite Type PG series, Tier 22 Handhole and lid with "Communications" logo on cover of lid.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Provide two (2) 3x3 "MaxCell" innerducts in two of the 4" conduits entering building from OSP system. Provide conduits over 1" not filled with MaxCell, install 3/8” nylon rope with a pull rating of 200lb or more. Conduits 1" or less, fill with polyline (Greenlee 430). Each MaxCell is to have different color ID marking and shall be locatable. The use of flexible plastic innerduct shall not be permitted.
B. The use of 90-degree bends shall be prohibited for OSP conduits. Long communications sweeps shall be utilized where conduit turns are required. Use Schedule 80 PVC, under sidewalks, driveways, etc. Use Schedule 40 PVC elsewhere. Conduit to be free of water and debris throughout. Provide caps on ends.

C. OSP conduits shall be marked with Detectable Warning Tape, CH Hansen 16626 or equal.

D. Handholes (HH) shall be 36"x48"x36" minimum size, with open bottom (on top of 4" rack). Seal conduits at each HH to keep moisture, insects, and rodents out of building. Conduits entering building must be sloped. All Handholes where fiber splices are made shall be 36"x60"x36" minimum. Use Quazite PG style with pull slot center pins, lid shall be labeled “COMMUNICATIONS”.

E. All OSP cabling shall be installed in neat and workmanlike manner. Cabling to be routed and secured around edges of HH to create additional space for future cabling.

F. Provide 25 foot maintenance loop for fiber optic lines in one HH. Service loop to side of HH.

G. Label all OSP cabling as follows:
   1. “Caution Fiber Optic” adhesive marker every HH. Label to include SM an MM fiber count and "to and from".
   2. “Caution Fiber Optic” adhesive marker every 50' of exposed fiber in building (including in cable tray). Label to include SM and MM fiber count and "to and from".
   3. OSP UTP cables shall be labeled with permanent, neat penmanship in every HH with "to and from".

H. Prior to backfill, contractor shall arrange for inspection of OSP installation with ETSU ITS Department.

I. Prior to commencing with work, a pre-construction meeting will be held between the contractor’s telecommunications cabling installer and appropriate representatives of the ETSU Physical Plant, ITS Department. Installation requirements shall be carefully discussed at the pre-construction meeting. Discrepancies between contract documents and pre-construction meeting shall be called to the attention of Project Engineer immediately prior to commencing with any telecommunications installation work.

J. All conduit shall be installed such that the top of the conduit is a minimum of 24" below grade.

END OF SECTION 27 05 43
SECTION 27 05 53 - ADMINISTRATION / LABELING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Provide administration and labeling of entire communications infrastructure in accordance with ETSU ITS Department requirements and as set forth hereinafter. Administration and labeling shall include but not be limited to all work area outlets (WAO’s), patch panels, 110 blocks, conduits, cable trays, backbone cables, etc.

1.2 REFERENCE STANDARDS

A. See SECTION 27.01.00 REFERENCE STANDARDS

B. See ETSU ITS Design and Installation Standards Policy – current edition

PART 2 - PRODUCTS

2.1 MATERIALS

A. Products shall be as set forth elsewhere in these specifications.

PART 3 – EXECUTION

3.1 INSTALLATION

A. All WAO’s, patch panels, 110 blocks, conduits, cable trays, backbone cabling, outside plant cabling, etc., shall be labeled according to ANSI/TIA Standards with specific labeling scheme of ETSU ITS Department. Labeling is also to include the following:

1. "Caution Fiber Optic" adhesive marker every 20’ of exposed fiber in building (including in cable tray). Label to include SM and MM fiber count and "to and from".

END OF SECTION 27 05 53
SECTION 27 08 00 - COMMISSIONING OF COMMUNICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Telecommunications systems shall be provided as indicated on drawings and as called for hereinafter.

1.2 REFERENCE STANDARDS

C. ANSI/NECA/BICSCI-568, Standard for Installing Commercial Building Telecommunications Cable.
D. ANSI/TIA 569-C, Pathways and Spaces.
E. ANSI/TIA 568-C.0, Generic Telecommunications for Customer Premises Standard Series
   568-C.1 Commercial Building Cabling
   568-C.2 Copper Cabling Components
   568-C.3 Fiber Cabling Components
   568-C.4 Coax Cabling Components
F. ANSI/TIA 606-B, Addendum 1, Administration Standard for Commercial Telecommunications Infrastructure.
G. ANSI J-STD-607-B, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
H. ANSI/TIA 758-B, Customer owned Outside Plant Telecommunications Cabling Standard
I. ANSI/TIA-526, 7&14, Telecommunications Measurements of Optical Fiber Single and Multi Mode Power Loss
K. ANSI/TIA 310-D, Cabinets, Racks, Panels, and Associated Equipment.
L. FCC Part 68, Connection of Terminal Equipment to the Telephone Network.
M. ADA of 2010 and Telecommunications Act of 1996, Physically Impaired and Accessibility.
O. IEEE 802.11ax Wireless LAN's
S. ETA Electronic Technician Association Fiber Optics Installer
T. FOA Fiber Optics Association Certified Fiber Optics Technician
U. ANSI/SCTE 77 Underground Enclosure Integrity

1.3 REFERENCE SPECIFICATIONS
A. See section 27.01.00 for standards.
B. See section 27.05.53 Administration/Labeling.
C. See section 27.05.26 Grounding and bonding.
D. See section 27.15.00 Voice and Network Horizontal Cabling System

PART 2 - PRODUCTS
2.1 INSPECTIONS AND WALK THROUGH
A. All work is subject to inspection and review at anytime by qualified ETSU personnel.
B. All rough in work will be inspected by ETSU personnel before finished walls and ceilings are installed.
C. Final walk through inspections must be done prior to turning in final documentation and test results. The preliminary documentations will be made available for review during this walk through inspection.
D. Cables with visible defects, kinks, twists, crushed, cuts or smashed will be replaced regardless if they pass tests.
E. Installer must take reasonable steps to protect their installation in a construction environment. Free of dirt, defects and debris

PART 3 - EXECUTION
3.1 Commissioning
A. ETSU ITS requires the newly installed infrastructure to be tested and certified. Follow the Standards of ANSI/TIA -568-C.1,2,3,4 for testing criteria of the permanent link. See Appendix D in the ETSU Telecommunications Design and Installations Guidelines, current edition for approved test equipment to obtain a manufacture warranty.
B. Testing shall commence only after all materials are permanently installed, adjusted, bonded and labeled. Installer must retest and save both the original and retested results when any of the above occurs.
C. Testing shall commence only in a clean environment, free of moisture, dirt, dust and debris. Terminations exposed to such environments after testing will require retesting.

D. In addition to the cabling being commissioned and certified, the electrical grounding and bonding systems must also be tested and certified.

E. The electrical contractor is responsible for testing the Alternating Current (AC) Grounding Electrode System.

F. The telecommunications installer is responsible for testing the Equipment Grounding (Bonding) System.

G. Refer to the BICSI TDMM latest edition, for approved test equipment and acceptable results.

END OF SECTION 27 08 00
SECTION 27 11 10 - TELECOMMUNICATIONS SPACES

PART 1 - GENERAL

1.1 DESCRIPTION
   A. Telecommunications spaces shall be provided as indicated on drawings and as called for hereinafter.
   B. There shall be one equipment room (ER) for the entire building.
   C. There shall be at least one telecommunications room (TR) on each floor per 10,000 sq.ft.

1.2 REFERENCE STANDARDS
   A. See section 27.01.00 for standards.
   B. See section 27.05.53 Administration/Labeling.
   C. See section 27.05.26 Grounding and bonding.
   D. See ETSU ITS Design and Installation Standards Policy – current edition

PART 2 - PRODUCTS

2.1 MATERIALS
   A. ER layouts shall include network racks, vertical wire management, cable trays, and associated facilities. Each ER shall include, but not be limited to, the following equipment:
      1. Equipment Racks shall be Hubbell No. CS1976, 84" x 19" with 6" channel vertical wire management or equivalent. Provide a Hubbell RKTGB grounding bus bar in each equipment room. Provide a Hubbell MCCPSS19TS surge protected power strip for each network rack. Provide cable management components at each rack including Hubbell HS23C(2 per patch panel) horizontal management, Hubbell MCCPSR4 cable management rings, and Hubbell 110RA cable management troughs. Provide Hubbell MCCCS19P equipment shelves. Provide Hubbell HRRP3 rack base insulator kit.
      3. Ladder Tray: In each ER room, provide 18" wide cable tray around room and to each rack. Cable tray shall be Hubbell Next Frame 18" "HL" Series or approved equal.
      4. Plywood Backboards: All walls of each ER room shall be provided with 3/4" AC grade plywood, covered on all six sides with two coats of Benjamin Moore M59-220 (white) paint, with up to 2 ounces of tint allowed per gallon.
      5. All fiber, OSP and Riser shall be terminated
PART 3 - EXECUTION

3.1 INSTALLATION

A. Furnish and install at each ER location a grounding conductor from grounding bus in local ER Room AC panelboard to grounding bus bar mentioned in 2.01, A, Materials. Grounding conductors shall be copper, with "THHN/THWN" insulation, with green tape marking to indicate grounding conductor. Refer to drawings for grounding conductor sizes. Grounding and bonding shall be in accordance with BICSI TDMM current edition, Chapter 8, and NFPA 70.

B. Before any terminations and installation of equipment, the ER must be in finished stage, free of dust and debris with all walls and ceilings painted to finish coats and finished flooring installed and treated. After terminations and equipment are installed, contractor shall keep ER room door closed and locked at all times.

END OF SECTION 27 11 10
SECTION 27 11 13 - COMMUNICATION ENTRANCE PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION
A. Telecommunications systems shall be provided as indicated on drawings and as called for hereinafter.

1.2 REFERENCE STANDARDS
C. ANSI/NECA/BICSCI-568, Standard for Installing Commercial Building Telecommunications Cable.
D. ANSI/TIA 569-C, Pathways and Spaces.
E. ANSI/TIA 568-C.0, Generic Telecommunications for Customer Premises Standard Series
   568-C.1 Commercial Building Cabling
   568-C.2 Copper Cabling Components
   568-C.3 Fiber Cabling Components
   568-C.4 Coax Cabling Components
F. ANSI/TIA 606-B, Addendum 1, Administration Standard for Commercial Telecommunications Infrastructure.
G. ANSI J-STD-607-B, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
H. ANSI/TIA 758-B, Customer owned Outside Plant Telecommunications Cabling Standard
L. FCC Part 68, Connection of Terminal Equipment to the Telephone Network.
U. ANSI/SCTE 77 Underground Enclosure Integrity
PART 2 - PRODUCTS

2.1 ENTRANCE FACILITY (EF) UTP PROTECTORS

A. An EF is a space where telecommunications outside plant (OSP) terminates to the inside facilities. The outside plant will most likely be fiber optics LAN, CATV coax, UTP telephone and MaxCell innerduct. (27 11 13)

B. UTP protectors shall have the following:

1. Building Entrance Terminals enclosure
2. INDOOR - 110 CONNECTOR
3. 16 AWG Powder Coated Steel Construction
4. Equipped with an Internal 26 AWG Fuse Link
5. External Ground Connectors Accept 6 - 14 AWG Wire
6. Industry Standard 5 Pin Design
7. Exceeds UL497 Primary Protection Standards

PART 3 - EXECUTION

3.1 INSTALLATION

A. OSP cables routed inside a building are influenced by fire codes. The installer should be aware of and adhere to local codes, standards and regulations.

B. OSP cable is to be terminated or transitioned to listed cable as close as practical upon entry to the building. In no case must this termination or transition exceed 50 feet from point of entrance for exposed cable. The installer may extend the point of entry by enclosing the unlisted outside cables in a rigid or intermediate metal conduit that extends beyond the wall or floor of the building and is properly sealed and bonded to a grounding electrode. At no point shall this cable be exposed prior to the termination point.

C. All telephone and data cables (Cat 3) and (Cat 5) shall be protected at the entrance facility.

D. Manufacture: UTP Protectors (CAT3) Circa 1880 series, 110 block, 5 pin modules 4B1S-300. CAT5e, Linx CAT5e-75

END OF SECTION 27 11 13
PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install voice and network cabling for the building as indicated on drawings and as called for hereinafter. This specification is for a voice and network cabling system. Products specified hereinafter are Hubbell, Mohawk or Belden cable and Hubbell connectivity including jacks, patch panels, patch cords, and faceplates shall be utilized. The Hubbell products specified hereinafter are utilized as campus standard for ETSU. Any proposed replacement products must meet or exceed the published specifications. Alternates must be verified with ETSU ITS by furnishing proper documentation of specifications verified by an industry-recognized test laboratory (U.L., ETL, ASTM).

B. This standard also establishes performance criteria for various system configurations and their elements.

C. Installer of cabling installation specified herein must be a certified trained installer using ANSI TIA Standards and the current edition of the BICSI TDMM (Telecommunications Distribution Methods Manual, Current Edition) as a guide for installation of inside cabling and associated components. Installer must be Hubbell Certified. Provide written documentation of these qualifications as part of the submittal process.

1.2 CABLE STRUCTURE

A. The elements of a cabling system are listed below:

1. Horizontal Cabling
2. Work Area Outlets (WAO)
3. ER Rooms (See Section 27.11.00)
4. TR Rooms (See Section 27.11.00)

B. HORIZONTAL CABLES

1. Horizontal cabling shall be of star topology, each work area connector shall be terminated in the telecommunications room. The maximum horizontal distance from ER to the WAO shall be 90 meters. When deductions are made for mandatory minimum slack, the cable distance is approximately 85 meters (281 feet).

2. The amount of untwisting of individual pairs to terminate shall be less than or equal to .5 in. for Category 6.

3. Minimum bend radius shall be 4 times the cable diameter.

C. REFERENCE STANDARDS

1. See section 27.01.00 for standards.
2. See section 27.05.53 Administration/Labeling.
3. See section 27.05.26 Grounding and bonding.
4. See section 270800 Commissioning of Communications
D. ADMINISTRATION STANDARD FOR COMMUNICATIONS INFRASTRUCTURE:

1. Purpose: The purpose of this standard is to provide a uniform administration scheme that is independent of the applications. This standard defines guidelines for contractors involved in the installation of the computer cabling system.

2. Scope: This standard specifies the administrative requirements of the communications infrastructure within a building or campus.

3. Areas to be administered are as follows:
   a. Terminations for the communications media
   b. Communications media between terminations
   c. Pathways between terminations
   d. Spaces where terminations are located
   e. Bonding and grounding

4. Pathway and Space Administration: All spaces must be labeled. Labels should be affixed at the entrance of the space.

5. Wiring System Administration: This section describes the administration of cables, termination hardware, splices and termination position. As changes are made, effected labels, records, drawings and reports shall be updated.

   a. Horizontal and backbone subsystem cables shall be labeled at each end.
   b. Each termination hardware or label shall be marked with an identifier.
   c. Each termination position label shall be recorded with an identifier.
   d. Each splice closure or label shall be marked with an identifier.
   e. "TMGB" shall be marked on the Telecommunications Main Grounding Busbar.

E. LABELING AND COLOR CODING:

1. Labels are divided into 3 categories:

   a. Adhesive labels shall meet adhesion, defacement and legibility requirements defined in U.L. 969. Labels shall also meet exposure requirements in U.L. 969.
   b. Insert labels shall also meet U.L. 969 requirements for defacement, legibility and general exposure.
   c. Other labels include special purpose labels, such as tie-on labels.
   d. Labels shall be used instead of marking the cable.

2. All bar codes shall be either Code 39 or Code 128 confirming to USS-39 and USS-128 respectively. All Code 39 bar code ratios shall be within 2.5:1 to 3.0:1. If a wand scanner is to be used, a minimum quiet zone of 6.35mm is required on each side of the bar code.

3. Refer to ITS Guidelines, Appendix M

F. COLOR CODING RULES:

1. Termination labels at the two ends of the cable shall be of the same color.
2. Cross-connectors made between termination fields are generally of two different colors.
3. The color orange is used for the demarcation point.
4. Green is for the network connections on the customer side of the demarcation point.
5. Purple is for the termination of cables originating from common equipment.
6. White is for the first level backbone media.
7. Gray is for the second level backbone.
8. Blue is for the termination of station telecommunicators media.
9. Brown is for inter-building backbone cable terminations.
10. Yellow is for termination of auxiliary circuits, alarms, security, and other miscellaneous circuits.

G. DIFFERENTIATION OF TERMINATION FIELDS BY PERFORMANCE CATEGORY
1. If cables are of different performance classes, their ends should indicate the difference. The labels shall be marked with the proper category of the cable.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wall-Station Jacks: All jacks are to be considered for data use and not voice.
   1. Network: Hubbell Speedgain, orange, HXJ6OR.

B. Wall-Station Faceplates: Wall station faceplates in office areas shall be Hubbell AFPI4EI Series with four port angled plate, color to match electrical outlets. All unused ports shall be provided with blank inserts, Hubbell SFBE10 Series. Provide blank inserts as required.

C. All access points (AP) will have the outlet terminated in a single gang work area outlet (WAO) on the nearest wall or column, within 15 feet of the proposed access point location. If the distance from WAO and access point is greater than 15 feet, install ¾" conduit to directly above access point.

D. Equipment Racks: See Section 27.11.10.

E. ER Cable Tray: See Section 27.11.10.

F. Voice and network horizontal cabling: Cabling shall be as specified in ITS Guidelines, Appendix A. All network cable shall have blue outer insulation. All voice cable shall have white outer insulation. Leave 8" of slack for each termination at wall outlet location. Leave one meter (3.28') slack at the end of each conduit run. Cable slack shall not be stored in bundled loops. Cable slack shall be stored in an extended loop or in a Figure 8 configuration. Provide two data cables to each communications outlet illustrated on the drawings, unless noted otherwise.

G. Patch Cords: Provide 6' grey patch cords to the ETSU ITS department. The patch cords shall be Hubbell model number PSX6GY. Provide one cable per patch panel port.

H. Backbone Fiber Optic Riser Cable: Single Mode – Corning MIC DX Armored Cable OS2 XXXE81-33131-DI (yellow); Multimode (50um) - Corning MIC DX Armored Cable OM3 XXXT81-33180-DI (aqua); XXX strand count. All fiber shall be terminated in fiber hubs per ETUS ITS standards.

I. Firestopping: Hilti CP-618 putty shall be installed inside the conduits and FS One or CP-653 re-entry sleeve shall be used outside and around the conduits. All firestopping shall be label as required by ANSI/TIA 606B.
PART 3 - EXECUTION

3.1 INTERIOR BUILDING INSTALLATION:

A. Installation of all voice and network wiring facilities shall be by installers certified by the manufacturer of the system(s) they are installing and be able to certify the installation for the manufacturer's warranty. Hubbell Premise Wiring will be the benchmarked used for equal or equivalent for material, methods and warranties for all local area network cabling.

B. All wiring shall be color coded and terminated. All cabling shall be Cat 6 terminated to T568A wiring scheme. All network cabling shall have blue outer insulation.

C. Submit shop drawings for approval.

D. Testing shall conform to ANSI/TIA-568-B.1 standard. Testing shall be accomplished using a Hubbell approved tester. Include tester calibration date. Refer to ITS DESP for Commissioning, Warranties, and Documentation.

E. All testing shall meet or exceed manufacturer's recommendation for 25-year warranty program.

G. During installation of cabling, the bend radius of cables is not to be less than the manufacturer's specific recommendation. Minimum bend radius shall be 10 times the diameter of the cable for fiber optic cable, and 4 times the diameter of the cable for copper cable. Contractor shall take and precaution not to exceed maximum tensile rating of cabling during installation.

H. Each horizontal cabling run shall include 10' of slack at telecommunications room end and 8" of slack at the outlet end. There shall also be one meter (3.28') of slack above each wall outlet. Station cables in the telecommunications rooms can be stored in a "Figure 8" configuration to maintain the proper bend radius and provide the needed slack.

I. All cables with noticable signs of damage, kinks, crush, or stress marks shall be replaced regardless of test results.

J. Labeling of cables, wall outlets, 110 blocks, conduits, cable trays, patch panels, and backbone cabling shall be performed in accordance with requirements of the ETSU ITS Department.

K. Building Automation System (BAS) Connection: Cabling connecting BAS to the ETSU ITS network must follow the standards set forth in ANSI/TIA 862.

END OF SECTION 27 15 00
SECTION 27 15 33 - COAXIAL CABLES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install a complete 1 GHz CATV wiring system as described on drawings and called for hereinafter.

B. The catalog numbers specified herein are those of the Blonder-Tongue Company and constitute the type and quality of the products to be installed.

C. The quality and type of CATV materials must be accepted by industry standards. All passive and active equipment must be two-way and pass signals up to one GHz "passive" and 750 MHz "active".

1.2 INSTALLER QUALIFICATIONS

A. Installation of CATV cabling system shall be done by personnel regularly engaged in installation of such facilities. Installers shall have NCTI, SCTE, and BICSI certifications. Provide documentation of these certifications as part of the submittal process. Installer shall have working knowledge of all codes/standards related to CATV wiring installation.

1.3 REFERENCE STANDARDS

A. SECTION 27.01.00 – REFERENCE STANDARDS

B. ANSI/SCE 74 2003, Specification for braided 75 ohm Flexible Coaxial Cable.

C. FCC Part 76, Cable Television Service.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Taps & Splitters: In the Telecommunications Room, install splitters to take the cable TV feed and distribute it to each individual room. Splitters/combiners shall be vertical ports, capable of passing one GHz signal with built-in grounding lug, Truespec DSVXG or equivalent. "X" represents the number of ports. Arrange splitters/combiners so that signal is evenly distributed among all ports. Provide vertical directional taps for riser cable RG11 or .500 as required.

B. Wall Plates: Wall plates for CATV outlets shall be flush mounted with single-gang Standard F81 through connector with 0 db isolation, and two data jack, Hubbell AFP14EI.

C. Coaxial Cable: Coaxial cable shall be installed from each television outlet location shown on drawings to the Telecommunications Room on a homerun basis. No series wiring for TV shall be permitted. The coaxial cable from the outlet to the Telecommunications Room shall be Belden 7915A Series RG6 cable, aluminum braid shield, flame retardant PVC jacket meeting NEC Article 820V rating, ETL listed or equivalent.
D. Coaxial Connectors: Use compression type, Belden Thomas and Betts FSNS6U.

E. Riser Coax installation:
   1. Riser Coax shall be RG11 Belden 9011 if under 300 feet and Comscope PIII 500 Plenum over 300ft.
   2. RG11 Fitting shall be Thomas and Betts 716SNS1P11H
   3. Coax .500 Series Fitting shall be Gilbert GRS-500-CH-DU-03-T

F. OSP Coax installation:
   1. OSP Coax shall be flooded type, CommScope PIII 500 JCASS (under 500ft) PIII 750 JCASS (over 500ft).
   2. Coax .500 Series Fitting shall be Gilbert GRS-500-CH-DU-03-T
   3. Coax .750 Series Fitting shall be Gilbert GRS-750-CH-DU-03-T

PART 3 - EXECUTION

3.1 INSTALLATION

A. Each coaxial cable shall be tested for signal loss, length of cable, and meet the manufacturers specifications. Testing shall be in accordance with FCC Part 76 signal leakage requirements. Coaxial cable tests will involve continuity and RF leakage, 20-uV/m leakage limit (10 feet from network). Limit will yield a dipole level of -43.67 dBmV 75 ohms. Carefully coordinate tie-in of incoming line with local cable operator. Complete TV feed to each individual outlet to verify that a proper signal is being distributed. After proper documentation disconnect each room at the headend location and make each connection for proper identification.

B. Cable drops shall be bundled by use of approved plastic ties. Tape shall not be permitted to bundle cable drops.

C. Grounding will meet NEC requirements for CATV. Refer to Article 820 of National Electrical Code for information.

END OF SECTION 27 15 33
SECTION 28 03 00 - FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section covers fire alarm systems, including initiating devices, notification appliances, controls, and supervisory devices.

B. Work covered by this section includes the furnishing of labor, equipment, and materials for installation of the fire alarm system as indicated on the drawings and specifications.

C. The Fire Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:

   1. Fire alarm and detection operations
   2. Control and monitoring of elevators, smoke control equipment, door hold-open devices, fire suppression systems, emergency power systems, and other equipment as indicated in the drawings and specifications.
   3. One-way supervised automatic voice alarm operations.

1.2 ACCEPTABLE MANUFACTURERS

A. Manufacturers: The equipment and service described in this specification are those supplied and supported by SimplexGrinnell and represent the base bid for the equipment. Substitutes will not be considered.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. The work covered by this section is to be coordinated with related work as specified elsewhere in the specifications. Requirements of the following sections apply:

   1. Division 26: "Basic Electrical Materials and Methods."
   2. Division 26: "Wiring Methods."
   3. Division 21: "Fire Protection"
   4. Division 23: "HVAC Systems"

C. The system and all associated operations shall be in accordance with the following:

   1. Guidelines of the following Building Code: BOCA
   2. NFPA 72, National Fire Alarm Code
   3. NFPA 70, National Electrical Code
1.4 SYSTEM DESCRIPTION

A. General: Provide a complete, non-coded, addressable microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein. Connect the new fire alarm panel to the existing toke and ring fire alarm network via fiber optic cable, make any and all fiber connections necessary for a complete fire alarm network.

B. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory. System shall be capable of storing dual configuration programs with one active and one in reserve. Panel shall be capable of full system operation during a new configuration download.

C. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.

D. Recording of Events: Record all alarm, supervisory, and trouble events by means of system printer. The printout shall include the type of signal (alarm, supervisory, or trouble) the device identification, date and time of the occurrence. The printout differentiates alarm signals from all other printed indications.

E. Wiring/Signal Transmission:
   1. Transmission shall be hard-wired, using separate individual circuits for each zone of alarm operation as required or addressable signal transmission, dedicated to fire alarm service only.
   2. System connections for initiating (signaling) circuits and notification appliance circuits shall be Class B.
   3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACP. Provide a distinctive indicating audible tone.

F. Remote Access:
   1. FACP shall have the capability to provide Remote Access through a Dial-Up Service Modem using the public switched telephone system of a private switched telephone system.
   2. A personal computer or technician's laptop, configured with terminal emulation software shall have the ability to access the FACP for diagnostics, maintenance reporting and information gathering.
   3. FACP shall have the capability to provide Remote Access through a listed Internet Interface via a standard web browser user interface.
G. Required Functions: The following are required system functions and operating features:

1. Priority of Signals: Alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second-, third-, and fourth-level priority respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.

2. Noninterfering: An event on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACP after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent activations.

3. Transmission to Remote Central Station: Automatically route alarm, supervisory, and trouble signals to a remote central station service transmitter provided under another contract.

4. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACP and the remote annunciator, indicating the location and type of device.

5. General Alarm: A system general alarm shall include:
   a. Indication of alarm condition at the FACP and annunciator(s).
   b. Identification of the device or zone that is the source of the alarm at the FACP.
   c. Operation of audible and visible notification devices throughout the building until silenced at FACP.
   d. Closing doors normally held open by magnetic door holders.
   e. Unlocking designated doors.
   f. Shutting down supply and return fans serving zone where alarm is initiated.
   g. Closing smoke dampers on system serving zone where alarm is initiated.
   h. Initiation of smoke control sequence through the building temperature control system.
   i. Notifying the local fire department.
   j. Initiation of elevator recall in accordance with ASME/ANSI A17.1, when specified detectors or sensors are activated.

6. Supervisory Operations: Upon activation of a supervisory device such as fire pump power failure, low air pressure switch, and tamper switch, the system shall operate as follows:
   a. Activate the system supervisory service audible signal and illuminate the LED at the control unit and the graphic annunciator.
   b. Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED “on” indicating off-normal condition.
   c. Record the event in the FACP historical log.
   d. Transmission of supervisory signal to remote central station.
   e. Restoring the condition shall cause the Supervisory LED to clear and restore the system to normal.

7. Alarm Silencing: If the "Alarm Silence" button is pressed, all audible alarm signals shall cease operation.
8. System Reset
   a. The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-alarming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."
   b. Should an alarm condition continue, the system will remain in an alarmed state.

9. A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.

10. WALKTEST: The system shall have the capacity of 8 programmable passcode protected one person testing groups, such that only a portion of the system need be disabled during testing. The actuation of the "enable one person test" program at the control unit shall activate the "One Person Testing" mode of the system as follows:
    a. The city circuit connection and suppression release circuits shall be bypassed for the testing group.
    b. Control relay functions associated to one of the 8 testing groups shall be bypassed.
    c. The control unit shall indicate a trouble condition.
    d. The alarm activation of any initiation device in the testing group shall cause the audible notification appliances to sound a voice announcement code to identify the device or zone.
    e. The unit shall automatically reset itself after signaling is complete.
    f. Any momentary opening of an initiating or notification appliance circuit wiring shall cause the audible signals to voice announce sound for 4 seconds indicating the trouble condition.

H. Analog Smoke Sensors:
   1. Monitoring: FACP shall individually monitor sensors for calibration, sensitivity, and alarm condition, and shall individually adjust for sensitivity. The control unit shall determine the condition of each sensor by comparing the sensor value to the stored values.
   2. Environmental Compensation: The FACP shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.
   3. Programmable Sensitivity: Photoelectric Smoke Sensors shall have 7 sensitivity levels ranging from 0.2% to 3.7%, programmed and monitored from the FACP.
   4. Sensitivity Testing Reports: The FACP shall provide sensor reports that meet NFPA 72 calibrated test method requirements. The reports shall be viewed on a CRT Display or printed for annual recording and logging of the calibration maintenance schedule.
   5. The FACP shall automatically indicate when an individual sensor needs cleaning. The system shall provide a means to indicate that a sensor requires cleaning. When a sensor's average value reaches a predetermined value, (3) progressive levels of reporting are provided. The first level shall indicate that a sensor is close to a trouble reporting condition and will be indicated on the FACP as "ALMOST DIRTY." This condition provides a means to alert maintenance staff of a dirty sensor without creating a trouble in the system. If this indicator is ignored, a second level "DIRTY SENSOR" condition shall be indicated at the FACP and subsequently a system trouble is reported. The sensor base LED shall glow steady giving a visible indication at the sensor location. The "DIRTY SENSOR" condition shall not affect the sensitivity level required to alarm the sensor. If a "DIRTY SENSOR" is left unattended, and its average value increases to a third predetermined value, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control unit.
6. The FACP shall continuously perform an automatic self-test on each sensor which will check sensor electronics and ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition.

7. Multi-Sensors shall combine photoelectric smoke sensing and heat sensing technologies. An alarm shall be determined by either smoke detection, with selectable sensitivity from 0.2 to 3.7 ‰/ft obscuration; or heat detection, selectable as fixed temperature or fixed with selectable rate-of-rise; or based on an analysis of the combination of smoke and heat activity.

8. Programmable bases. It shall be possible to program relay and sounder bases to operate independently of their associated sensor.

9. Magnet test activation of smoke sensors shall be distinguished by its label and history log entry as being activated by a magnet.

I. Smoke Detectors: A maintenance and testing service providing the following shall be included with the base bid:

1. Biannual sensitivity reading and logging for each smoke sensor.
2. Scheduled biannual threshold adjustments to maintain proper sensitivity for each smoke sensor.
3. Threshold adjustment to any smoke sensor that has alarmed the system without the presence of particles of combustion.
4. Scheduled biannual cleaning or replacement of each smoke detector or sensor within the system.
5. Semi-annual functional testing of each smoke detector or sensor using the manufacturer's calibrated test tool.
6. Written documentation of all testing, cleaning, replacing, threshold adjustment, and sensitivity reading for each smoke detector or sensor device within the system.
7. The initial service included in the bid price shall provide the above listed procedures for a period of five years after owner acceptance of the system.

J. Audible Alarm Notification: By voice evacuation and tone signals on loudspeakers in areas as indicated on drawings.

1. Automatic Voice Evacuation Sequence:
   a. The audio alarm signal shall consist of an alarm tone for a maximum of five seconds followed by an automatic digital voice message. At the end of the voice message, the alarm tone shall resume. This sequence shall sound continuously until the "Alarm Silence" switch is activated.
   b. All audio operations shall be activated by the system software so that any required future changes can be facilitated by authorized personnel without any component rewiring or hardware additions.

K. Speaker: Speaker notification appliances shall be listed to UL 1480.

1. The speaker shall operate on a standard 25VRMS or 70.7VRMS NAC using twisted/shielded wire.
2. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet.
3. The speaker shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for General Signaling.
L. Manual Voice Paging

1. The system shall be configured to allow voice paging. Upon activation of any speaker manual control switch, the alarm tone shall be sounded over all speakers in that group.
2. The control panel operator shall be able to make announcements via the push-to-talk paging microphone over the pre-selected speakers.
3. Facility for total building paging shall be accomplished by the means of an "All Call" switch.

M. Fire Suppression Monitoring:

1. Water flow: Activation of a water flow switch shall initiate general alarm operations.
2. Sprinkler valve tamper switch: The activation of any valve tamper switch shall activate system supervisory operations.
3. WSO: Water flow switch and sprinkler valve tamper switch shall be capable of existing on the same initiating zone. Activation of either device shall distinctly report which device is in alarm on the initiating zone.

N. Power Requirements

1. The control unit shall receive AC power via a dedicated fused disconnect circuit.
2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with 15 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.
3. All circuits requiring system-operating power shall be 24 VDC and shall be individually fused at the control unit.
4. The incoming power to the system shall be supervised so that any power failure will be indicated at the control unit. A green "power on" LED shall be displayed continuously while incoming power is present.
5. The system batteries shall be supervised so that a low battery or depleted battery condition or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.
6. The system shall support NAC Lockout feature to prevent subsequent activation of Notification Appliance Circuits after a Depleted Battery condition occurs in order to make use of battery reserve for front panel annunciation and control.
7. The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.
8. Loss of primary power shall sound a trouble signal at the FACP. FACP shall indicate when the system is operating on an alternate power supply.

1.5 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

1. Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.
2. Wiring diagrams from manufacturer.
3. Shop drawings showing system details including location of FACP, all devices, circuiting and details of graphic annunciator.
4. System Power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate per the prescribed backup time periods and under all voltage conditions per UL and NFPA standards.
5. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, NAC, relay, sensor, and auxiliary control circuits.
6. Operating instructions for FACP.
7. Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.
8. Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.
9. Record of field tests of system.

B. Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of shop drawings as required to depict component locations to facilitate review. Upon receipt of comments from the Authority, make resubmissions if required to make clarifications or revisions to obtain approval.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A factory authorized installer is to perform the work of this section.

B. Each and all items of the Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by Underwriters Laboratories, Inc. (UL), and shall bear the "UL" label.

1.7 MAINTENANCE SERVICE

A. Maintenance Service Contract: Provide maintenance of fire alarm systems and equipment for a period of 12 months, using factory-authorized service representatives.

B. Basic Services: Systematic, routine maintenance visits on a quarterly basis at times scheduled with the Owner. In addition, respond to service calls within 24 hours of notification of system trouble. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.

C. Additional Services: Perform services within the above 12-month period not classified as routine maintenance or as warranty work when authorized in writing. Compensation for additional services must be agreed upon in writing prior to performing services.
PART 2 - PRODUCTS

2.1 FIRE ALARM CONTROL PANEL (SIMPLEX 4100-9111)

A. General: Comply with UL 864, "Control Units for Fire-Protective Signaling Systems."

B. The following FACP hardware shall be provided:

1. Power Limited base panel with beige cabinet and door, 120 VAC input power.
2. 2,000 point capacity where (1) point equals (1) monitor (input) or (1) control (output).
3. 2,000 points of Network Annunciation at FACP Display when applied as a Network Node
4. 2000 points of annunciation where one (1) point of annunciation equals:
   a. 1 LED driver output on a graphic driver or 1 switch input on a graphic switch input module.
   b. 1 LED on panel or 1 switch on panel.
5. From all battery charging circuits in the system provide battery voltage and ammeter readouts on the FCP LCD Display.
6. Municipal City Circuit Connection with Disconnect switch, 24VDC Remote Station (reverse polarity), local energy, shunt master box, or a form "C" contact output.
7. One Auxiliary electronically resetable fused 2A @ 24VDC Output, with programmable disconnect operation for 4-wire detector reset.
8. One Auxiliary Relay, SPDT 2A @ 32VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.
9. Where required provide Intelligent Remote Battery Charger for charging up to 110Ah batteries.
10. Power Supplies with integral intelligent Notification Appliance Circuit Class B for system expansion.
11. Four (4) form "C" Auxiliary Relay Circuits (Form C contacts rated 2A @ 24VDC, resistive), operation is programmable for trouble, alarm, supervisory of other fire response functions. Relays shall be capable of switching up to ½ A @ 120VAC, inductive.
12. The FACP shall support (6) RS-232-C ports and one service port.
13. Remote Unit Interface: supervised serial communication channel for control and monitoring of remotely located annunciators and I/O panels.
14. Programmable DACT for either Common Event Reporting or per Point Reporting.
15. Service Port Modem for dial in passcode access to all fire control panel information.

C. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures.

D. Alphanumeric Display and System Controls: Panel shall include an 80 character LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.
E. Voice Alarm: Provide an emergency communication system, integral with the FACP, including voice alarm system components, microphones, amplifiers, and tone generators. Features include:

1. Amplifiers comply with UL 1711, "Amplifiers for Fire Protective Signaling Systems." Amplifiers shall provide an onboard local mode temporal coded horn tone as a default backup tone. Test switches on the amplifier shall be provided to test and observe amplifier backup switchover. Each amplifier shall communicate to the host panel amplifier and NAC circuit voltage and current levels for display on the user interface.
2. All announcements are made over dedicated, supervised communication lines. All risers shall support Class B wiring for each audio channel.
3. Emergency voice communication audio controller module shall provide up to 32 minutes of message memory for digitally stored messages. Provide supervised connections for master microphone.

F. Fiber Optic Modem: Network communications shall be via Simplex 4100U Fiber Optic Modems. The fiber modems shall allow Full Duplex/Bi-Directional Network and Audio Communications over a single Fiber Optic Cable. Modems shall use Type ST fiber connections. Modems shall use Multi-Mode 62.5 micron fiber cable. Fiber transmission shall be via split frequency utilizing 1310nm and 1550nm. 4100-6074 Left Port Fiber Modem Assemble, and 4100-6075 Right Port Fiber Modem Assembly.

2.2 REMOTE CRTS, PC ANNUNCIATOR AND PRINTERs

A. Fire Alarm Control Unit shall be capable of operating remote CRT's and/or printers; output shall be ASCII from an RS-232-C connection with an adjustable baud rate.

B. Fire Alarm Control Unit shall be capable of operating a PC Annunciator which provides status annunciation and limited system control using a convenient and familiar Microsoft Windows® 2000 operating system based interface. PC Annunciator shall provide the following functions:

1. Login/logout password protection with time duration selectable automatic logout
2. Displays Alarm, Supervisory, Priority 2, and Trouble conditions with numerical tallies for each
3. Displays first and last alarms
4. Different event types have separate visible indicators with a common audible indicator
5. Event logs can be searched and printed
6. View and/or print TrueAlarm status reports and service reports (printing requires an available local or network printer)
7. Alarm Silence; System Reset; and Priority 2 Reset
8. Global and individual point acknowledge
9. Set system time and date; and clear event log
10. Individual point access for control or parameter revisions

C. Each RS-232-C port shall be capable of supporting and supervising a remote Printer; the FACP shall support as many as two (2) remote displays. The Fire Alarm Control Panel shall support five (5) RS-232-C ports.
2.3 REMOTE LCD ANNUNCIATOR (SIMPLEX 4603-9101)

A. Provide Remote LCD Annunciator with the same "look and feel" as the FACP operator interface. The Remote LCD Annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys, Status LEDs and LCD Display as the FACP.

B. Annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with four (4) programmable control switches and associated LEDs.

C. Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.

D. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.

E. The LCD shall display the following information relative to the abnormal condition of a point in the system:
   1. 40 character custom location label.
   2. Type of device (e.g., smoke, pull station, waterflow).
   3. Point status (e.g., alarm, trouble).

F. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACP.

G. General: Components include battery, charger, and an automatic transfer switch.

H. Battery: (SIMPLEX 2081-9276) Sealed lead-acid. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm indicating devices in alarm or supervisory mode for a period of 15 minutes.

2.4 ADDRESSABLE MANUAL PULL STATIONS (SIMPLEX 4099-9001)

A. Description: Addressable single-action type, red LEXAN, with molded, raised-letter operating instructions of contrasting color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units.

B. Protective Shield: Where required provide a tamperproof, clear LEXAN shield and red frame that easily fits over manual pull stations. When shield is lifted to gain access to the station, a battery powered piercing warning horn shall be activated. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.

2.5 SMOKE SENSORS

A. General: Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:
   1. Factory Nameplate: Serial number and type identification.
2. Operating Voltage: 24 VDC, nominal.
3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
4. Each sensor base (SIMPLEX 4098-9792) shall contain an LED that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the sensor base LED shall be on steady.
5. Each sensor base shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.
6. Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a “wrong device”, the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a “Wrong Device” trouble condition.
7. The sensor's electronics shall be immune from false alarms caused by EMI and RFI.
8. Sensors include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACP. Sensor address shall be located in base to eliminate false addressing when replacing sensors.
9. Removal of the sensor head for cleaning shall not require the setting of addresses.

B. Type: Smoke sensors shall be of the photoelectric (SIMPLEX 4098-9792) or combination photoelectric / heat type (SIMPLEX 4098-9602). Where acceptable per manufacturer specifications, ionization type sensors may be used.

C. Bases: Relay output, sounder and isolator bases shall be supported alternatives to the standard base.

D. Duct Smoke Sensor: (SIMPLEX 4098-9756) Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Sensor includes relay as required for fan shutdown.

1. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct sensor shall be provided by the FACP.
2. The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable. Relay shall be mounted within 3 feet of HVAC control circuit.
3. Duct Housing shall provide a relay control trouble indicator Yellow LED.
4. Compact Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.
5. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.
6. Duct Housing shall provide a magnetic test area and Red sensor status LED.
7. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
8. Each duct sensor shall have a Remote Test Station with an alarm LED and test switch.
9. Where indicated a NEMA 4X weatherproof duct housing enclosure shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.
2.6 HEAT SENSORS (SIMPLEX 4098-9733)

A. Thermal Sensor: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; 135-deg F fixed-temperature setting except as indicated.

B. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.

C. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and programmable to operate at 135-deg F or 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACP for either 15-deg F or 20-deg F per minute.

D. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.

2.7 ADDRESSABLE CIRCUIT INTERFACE MODULES (SIMPLEX 4090-9001)

A. Addressable Circuit Interface Modules: Arrange to monitor one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of evacuation indicating appliances and AHU systems.

B. All Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACP. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

2.8 MAGNETIC DOOR HOLDERS (SIMPLEX 2088-9608)

A. Description: Units shall be listed to UL 228. Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Unit shall operate from a 120VAC, a 24VAC or a 24VDC source, and develops a minimum of 25 lbs. holding force.

B. Material and Finish: Match door hardware.

2.9 STANDARD ALARM NOTIFICATION APPLIANCES

A. VISIBLE ONLY: (SIMPLEX 4906-9101) Strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. V/O appliances shall be provided with selectable flash intensities of 15cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.
B. SPEAKER/VISIBLE: (SIMPLEX 4906-9151) Combination Speaker/Visible (S/V) units combine the speaker and visible functions into a common housing. The S/V shall be listed to UL 1971 and UL 1480.

1. Twisted/shielded wire is required for speaker connections on a standard 25VRMS or 70.7VRMS NAC using and UTP conductors, having a minimum of 3 twists per foot is required for addressable strobe connections.

2. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet.

3. The S/V shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for General Signaling.

4. The S/V installs directly to a 4” square, 1 1/2 in. deep electrical box with 1 1/2” extension

C. Accessories: The contractor shall furnish the necessary accessories.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install system components and all associated devices in accordance with applicable NFPA Standards and manufacturer's recommendations.

B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:

1. Factory trained and certified personnel.

2. National Institute of Certification in Engineering Technologies (NICET) fire alarm level II certified personnel.

3. Personnel licensed or certified by state or local authority.

3.2 EQUIPMENT INSTALLATION

A. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, and all other necessary material for a complete operating system.

B. All fire alarm panels shall be monitored and networked via the existing campus fiber optic network.

C. Equipment Removal: After acceptance of the new fire alarm system, disconnect and remove the existing fire alarm equipment and restore damaged surfaces. Package operational fire alarm and detection equipment that has been removed and deliver to the Owner. Remove from the site and legally dispose of the remainder of the existing material. Remove all associated conduit and wiring. Provide blank cover plate over all abandoned outlets recessed in walls.

D. Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised.
3.3 WIRING INSTALLATION

A. System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction (AH) and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electric Code (NEC).

B. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.

C. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.

3.4 FIELD QUALITY CONTROL

A. Manufacturer’s Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

B. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:

1. Factory trained and certified.
2. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.
3. International Municipal Signal Association (IMSA) fire alarm certified.
4. Certified by a state or local authority.
5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.

C. Pretesting: Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.

D. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.

E. Minimum System Tests: Test the system according to the procedures outlined in NFPA 72.

F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log.
H. Final Test, Certificate of Completion, and Certificate of Occupancy:

1. Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy.

3.5 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.

B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

3.6 TRAINING

A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.

1. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 8 hours' training.

2. Schedule training with the Owner at least seven days in advance.

END OF SECTION 28 03 00
SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and removing site utilities.
8. Temporary erosion and sedimentation control.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

C. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.

D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and
other objects larger than 2 inches (50 mm) in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.

E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.

G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.

2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Topsoil stripping and stockpiling program.

C. Rock stockpiling program.

D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

E. Burning: Documentation of compliance with burning requirements and permitting of authorities having jurisdiction. Identify location(s) and conditions under which burning will be performed.

1.7 QUALITY ASSURANCE

A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.
B. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

1.8 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
   1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Utility Locator Service: Notify utility locator service (One Call) for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

F. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."

G. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
   1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

B. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #23 (surface-tolerant, anticorrosive metal primer) or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.
PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in documents.

C. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site according to requirements in drawings.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain that are damaged by construction operations. Trees overly damaged in the opinion of the Civil Engineer shall be replaced by new trees at the contractor’s expense. For every inch of caliper of the existing tree, the contractor shall provide a number of new trees, minimum 2 inch caliper at 1 foot above grade to add up to the caliper of the tree removed of the same species or comparable as approved by the Owner. New trees shall have a replacement warranty of two years with maintenance by Owner.

3.4 EXISTING UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
   1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
   1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Locate, identify, and disconnect utilities indicated to be abandoned in place.

D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than seven days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

E. Excavate for and remove underground utilities indicated to be removed.

F. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and in Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition."

3.5 CLEARING AND GRUBBING

A. Perform clearing and grubbing well in advance of construction or material removal activities.

B. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Grub construction area of all protruding obstructions.
3. Grub borrow pit and stockpile areas of all objectionable material.
4. Grind down stumps and remove roots larger than 2 inches (50 mm) in diameter, obstructions, and debris to a depth of 24 inches below exposed subgrade.
5. Cut trees and remove stumps at areas of new embankments, grading, or outside the construction area where indicated on Engineer's drawings.
6. Use only hand methods or air spade for grubbing within protection zones.
7. Chip removed tree branches and dispose of off-site.
8. Trim branches of trees extending over road bed to a clear height of 20 feet above finished ground surface.
9. Remove low-hanging, unsound or unsightly branches on trees or shrubs designated to remain.

C. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), and compact each layer to a density equal to adjacent original ground.
2. Backfill embankment areas to natural ground elevation.
3. Backfill excavation areas below finished subgrade to finished subgrade.
4. Prepare areas designated on the Drawings to receive erosion control matting to smooth surfaces that have been shaped, fertilized, and seeded.
3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches (150 mm) in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches (1800 mm).
2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 STOCKPILING ROCK

A. Remove from construction area naturally formed rocks that measure more than 1 foot (300 mm) across in least dimension. Do not include excavated or crushed rock.

1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; trash, debris, weeds, roots, and other waste materials.

B. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.

1. Limit height of rock stockpiles to 36 inches (900 mm).
2. Do not stockpile rock within protection zones.
3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus rock to allow later use by the Owner.

3.8 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.
3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Burning tree, shrub, and other vegetation waste is prohibited. Burning of other waste and debris is prohibited.

C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 31 10 00
SECTION 31 20 00 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Preparing subgrades for slabs-on-grade walks pavements turf and grasses and plants.
   2. Excavating and backfilling for buildings and structures.
   4. Subbase course and base course for asphalt paving.

B. Related Requirements:
   1. Section 024100 "Demolition"
   2. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.

1.3 UNIT PRICES

A. Work of this Section is affected by unit prices for earth moving specified in Section 012200 "Unit Prices."

B. Quantity allowances for earth moving are included in Section 012100 "Allowances."

C. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.
   1. 24 inches (600 mm) outside of concrete forms other than at footings.
   2. 12 inches (300 mm) outside of concrete forms at footings.
   3. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
   4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
   5. 6 inches (150 mm) beneath bottom of concrete slabs-on-grade.
   6. 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

1.4 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated:
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work per unit prices.
   2. Bulk Excavation: Excavation more than 10 feet (3 m) in width and more than 30 feet (9 m) in length.
   3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. (0.76 cu. m) for bulk excavation or 3/4 cu. yd. (0.57 cu. m) for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
   1. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- (1065-mm-) maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp (103-kW) flywheel power with bucket-curling force of not less than 28,700 lbf (128 kN) and stick-crowd force of not less than 18,400 lbf (82 kN) with extra-long reach boom.
   2. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp (172-kW) flywheel power and developing a minimum of 47,992-lbf (213.3-kN) breakout force with a general-purpose bare bucket.

I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. (0.57 cu. m) or more in volume that exceed a standard penetration resistance of 100 blows/2 inches (97 blows/50 mm) when tested by a geotechnical testing agency, according to ASTM D 1586.

J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

M. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct preexcavation conference at Project site.

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:
   a. Personnel and equipment needed to make progress and avoid delays.
   b. Coordination of Work with utility locator service.
   c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
   d. Extent of trenching by hand or with air spade.
   e. Field quality control.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.
3. Geofoam.
4. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches (300 by 300 mm).
2. Warning Tape: 12 inches (300 mm) long; of each color.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to ASTM D 698.

C. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.
1.8 QUALITY ASSURANCE

A. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:
   1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
   2. Seismographic monitoring during blasting operations.

B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:
   1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
   2. Seismographic monitoring during blasting operations.

C. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.9 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
   1. Do not proceed with work on adjoining property until directed by Architect.

C. Utility Locator Service: Notify utility locator service "One Call" for area where Project is located before beginning earth-moving operations.

D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls" and Section 311000 "Site Clearing" are in place.

E. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

F. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

I. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Satisfactory soil shall be clean soil free of organics, trash, and other deleterious matter, containing no rock fragments greater than 4 inches in any one dimension. Satisfactory fill shall have a Standard Proctor (ASTM D-698) dry unit weight of greater than 90 pcf and a plasticity index (PI) of less than 30 percent (a PI of less than 20 is more preferable, but soils with PIs below 20 may not be readily available in this area). All material to be used as satisfactory soils shall be tested and approved by the geotechnical engineer before being placed.


D. Terms, descriptions, and gradations of materials below are examples only. Revise to comply with local practices and to suit Project. For example, soil materials may be referenced by state or local highway designations rather than by ASTM classifications.

E. Backfill and Fill: Satisfactory soil materials.

F. Base: Base material shall be as specified on the construction plans.

G. Bedding: Bedding material shall be as specified on the construction plans and in accordance with the Tennessee Department of Transportation (TDOT) standards and specifications.

H. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

I. Detectable Warning Tape: Polyethylene film warning tape encasing a metallic core, minimum 6-inches wide and 4-mils thick, continuously inscribed with a description of the utility.
J. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Survivability: As follows:
   a. Grab Tensile Strength: 157 lbf (700 N); ASTM D 4632.
   b. Sewn Seam Strength: 142 lbf (630 N); ASTM D 4632.
   c. Tear Strength: 56 lbf (250 N); ASTM D 4533.
   d. Puncture Strength: 56 lbf (250 N); ASTM D 4833.
3. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Survivability: As follows:
   a. Grab Tensile Strength: 247 lbf (1100 N); ASTM D 4632.
   b. Sewn Seam Strength: 222 lbf (990 N); ASTM D 4632.
   c. Tear Strength: 90 lbf (400 N); ASTM D 4533.
   d. Puncture Strength: 90 lbf (400 N); ASTM D 4833.
3. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.
4. Permittivity: 0.02 per second, minimum; ASTM D 4491.
5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:

2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm)
thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, freezing temperatures or frost, and other hazards created by earthwork operations. Provide protective insulating materials as necessary.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area. If the exposed subgrades become excessively wet or frozen, or if conditions that differ from those described in the Report of Subsurface Exploration, notify the engineer.

D. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

3.2 EXCAVATION, GENERAL

A. Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

B. Excavate for structures, pavements, and walks to indicated elevations and dimensions. Trim bottoms to required lines and grades to leave solid base to receive other work.

1. Comply with all OSHA requirements, as applicable.

2. Perform Dynamic Cone Penetrometer (DCP) testing in foundation excavations to verify that the specified bearing capacity exists in the foundation.

C. Excavate utility trenches to indicated gradients, lines, depths, and invert elevations of uniform widths to provide a working clearance on each side of pipe or conduit.

1. Excavate trenches deeper than bottom of pipe elevation to allow for bedding course where required. Hand excavate for bell of pipe if necessary.
D. Prior to placement of structural fill at the site or once design grade is achieved in cut areas, the site soils shall be evaluated by the geotechnical engineer through proof rolling. Proof roll subgrades with a loaded, tandem axle dump truck (minimum load of 20 tons). Areas judged to perform unsatisfactorily by the geotechnical engineer shall be undercut and replaced with structural fill or remediated at the geotechnical engineer's direction. Do not proof roll wet or saturated subgrades. Proofrolling may be required multiple times within the same area, depending on climatic conditions and the speed of contractor operations.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities.

F. Stockpile borrow materials and satisfactory soil materials, without intermixing, in shaped, graded, drained, and covered stockpiles. Stockpile soil materials away from edge of excavations and outside drip line of remaining trees.

G. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.3 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.
   
   1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.
   
   1. Clearance: 12 inches (300 mm) each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
   
   1. For pipes and conduit less than 6 inches (150 mm) in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
   2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
   3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
   4. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
   
   1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

E. Trenches in Tree- and Plant-Protection Zones:
1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 BACKFILLS AND FILLS

A. Utility Trench Backfill: Place, compact, and shape bedding course to provide continuous support for pipes and conduits over rock and other unyielding bearing surfaces and to fill unauthorized excavations.

1. Place and compact initial backfill of satisfactory soil material or subbase material, free of particles larger than 1-inch over the utility pipe or conduit as shown on the construction drawings. Place and compact final backfill of either crushed limestone gravel (base stone) or satisfactory soil material, according to location, to final subgrade.

B. Fill: Place and compact fill material in layers to required elevations.

C. Bench fill placed for slopes or within excavations into the adjacent ground. Use care to compact the benched fill and knit the fill into the then existing ground surface.

D. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

1. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

E. Compaction: Place structural fill materials in loose lifts, not more than 8-inches in thickness for material compacted by heavy compaction equipment, and not more than 4 to 6 inches in loose depth for material compacted by hand-operated tampers.

   a. Within the building areas, compact to at least 98% of the materials standard Proctor maximum dry density (ASTM D 698).

   b. Within drive and parking areas in the upper 2 feet from finished grade, compact to at least 100% of the materials standard Proctor maximum dry density (ASTM D 698). Below 2 feet, compact to at least 98% of the materials standard Proctor maximum dry density (ASTM D 698).

   c. Within slope areas, compact to at least 98% of the materials standard Proctor maximum dry density (ASTM D 698).

   d. Within the floor subgrade areas, compact to at least 100% of the materials standard Proctor maximum dry density (ASTM D 698).

   e. Within landscape areas, compact to at least 95% of the materials standard Proctor maximum dry density (ASTM D 698).

   f. Compaction of all fill soil plus 10 feet horizontally beyond the outside edge of building foundations and at least 5 feet horizontally beyond the edge of paved areas.
g. Moisture content of granular material shall be maintained low enough to allow for satisfactory compaction to be achieved without the cohesionless fill material pumping when proofrolled.

F. Each lift shall be compacted, tested by geotechnical personnel and approved before placing any subsequent lifts. The minimum rate of testing is 1 test per 2,500 square feet or less of fill area for each soil fill lift. Any areas which have become soft or frozen shall be removed before additional structural fill is placed.

G. Grading: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated. Grade lawns, walks, and unpaved subgrades to tolerances of plus or minus 1-inch and pavements and areas within building lines to plus or minus 1/2inch.

H. Base Courses: Under pavements, place base course material over subgrade. Compact to required grades, lines, cross sections, and thickness to not less than 100 percent of maximum dry unit weight according to ASTM D 698.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

B. Allow testing agency to test and inspect subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.5 PROTECTION AND DISPOSAL

A. Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

D. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 20 00
SECTION 31 23 00 - EXCAVATION AND FILL

PART 1—GENERAL

1.01 WORK INCLUDED

A. Excavation for piped utility material.
B. Provide necessary sheeting, shoring, and bracing.
C. Prepare trench bottom with appropriate materials.
D. Dewater excavation as required.
E. Place and compact granular beds as required, and backfill.

1.02 RELATED WORK

A. Section 31 11 00: Clearing and Grubbing.
B. Section 31 20 00: Earth Moving.
C. Section 32 12 00: Flexible Paving.
D. Section 03 00 00: Concrete.

1.03 PRECAUTIONS

A. Notify utility companies when necessary to disturb existing facilities and abide by their requirements for repairing and replacing. Call 811 to request a dig/location.
B. Protect all vegetation and other features to remain.
C. Protect all benchmarks and survey points. Property corners determined by the Engineer to be carelessly destroyed by the Contractor shall be replaced at no cost to the Owner. Replacement shall be performed by a Registered Land Surveyor and approved by the Engineer.

1.04 QUALITY ASSURANCE

A. Quality Control Testing During Construction: Contractor will engage density testing service for quality control testing during backfill operations beneath improved areas including but not limited to driveways, streets, sidewalks, etc., and where nonrigid and rigid type surfacing are to be replaced.

PART 2—PRODUCTS

2.01 BEDDING AND BACKFILL MATERIALS—SANITARY SEWERS

A. Class I Material: Angular, 1/4 to 1” graded stone, including a number of fill materials that have regional significance such as crushed stone, cinders, slag, and crushed shells meeting the following graduation requirements:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1”</td>
<td>100</td>
</tr>
<tr>
<td>3/4”</td>
<td>90-100</td>
</tr>
<tr>
<td>3/8”</td>
<td>20-55</td>
</tr>
<tr>
<td>#4</td>
<td>0-10</td>
</tr>
<tr>
<td>#8</td>
<td>0-5</td>
</tr>
</tbody>
</table>
B. Class II Material: Coarse sands and gravels with a maximum particle dimension of 1-1/2", including variously graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry.
C. Class III Material: Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures.
D. Class IV Material: Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits.
E. Class V Material: Organic soils, as well as soil containing frozen earth, debris, rocks larger than 1-1/2", and other foreign material.

2.02 BEDDING AND BACKFILL MATERIALS—STORM SEWERS
A. Class A Material: Continuous concrete cradle constructed in conformity with details shown on Drawings, consisting of Class “B” concrete as specified in Section 03 00 00.
B. Class B Material: Sand or a natural sandy soil, all passing a 3/8" sieve with not more than 10 percent passing a No. 200 sieve; or stone, gravel, chert, or slag of Graduation C or D of TDOT specifications.
C. Class C Material: Natural ground or compacted embankment at a depth of at least 10 percent of the outside vertical pipe diameter.
D. In rock cuts or other areas where free drainage bedding or backfill materials are required, use crushed stone, slag, or washed gravel of size 6, 7, 8, 57, or 78 of TDOT specifications.
E. For crushed stone pavement and shoulder replacement, use crushed stone meeting Type “A,” Grading D, of TDOT specifications.

PART 3—EXECUTION
3.01 PREPARATION
A. Install barriers and other devices to protect areas adjacent to construction.
B. Protect and maintain all bench marks and other survey points.

3.02 EXCAVATION TRENCHES
A. Perform in such a manner as to form a suitable trench in which to place the pipe and so as to cause the least inconvenience to the public.
B. Maximum width at the crown of the pipe—two feet plus the nominal diameter of the pipe.
C. Cut pavement along neat, straight lines with either a pavement breaker or pavement saw.
D. Trench depth: for waterlines—sufficient to provide minimum cover of 30" over the top of the pipe; for sewer lines—as shown on the Plans or as specified.
E. Align trench as shown on the Plans unless a change is necessary to miss an unforeseen obstruction.
F. For water pipe, shape the bottom of the trench to provide uniform bearing of the pipe on undisturbed earth throughout its entire length. Dig bell holes to aid in securing uniform support of the pipe.
G. For sewer pipe, fill the bottom of the trench with granular material as specified herein.
H. When unstable soil is encountered at the trench bottom, remove it to a depth required to assure support of the pipeline and backfill to the proper grade with coarse aggregate AASHTO M-43, Size No. 2 or 3. This will be a pay item under crushed stone for undercutting material.
I. Remove rock encountered in trench excavation to a depth of 6" below the bottom of the pipe barrel, backfill with an approved material, and compact to uniformly support the pipe. In no case
shall solid rock exist within 6” of the finished pipeline.

J. When rock borings or soundings are provided, they are for information only and do not guarantee existing conditions. Make such investigations as deemed necessary to determine existing conditions.

3.03 SHEETING, SHORING, AND BRACING

A. When necessary or when directed by the Engineer, furnish, put in place, and maintain such sheeting, bracing, etc., as may be required to support the sides of the excavation and to prevent movement.

B. Take care to prevent voids outside the sheeting.

C. If voids are formed, immediately fill and ram to the satisfaction of the Engineer.

D. Devise Plans for performing this work subject to the approval of the Engineer.

E. Unless adjacent facilities will be injured, remove all sheeting, shoring, and bracing after backfill has been placed to a depth of 18” over the pipeline.

F. Cut shoring off at the top of the pipe and leave the lower section in the trench.

3.04 USE OF EXPLOSIVES

A. Conduct all blasting operations in accordance with prevailing municipal, state or other agency regulations, codes, ordinances, or laws.

B. Exercise due caution when blasting adjacent to existing structures and pipelines.

C. If structures or pipelines are damaged, promptly replace or repair them at no expense to Owner.

D. Do not conduct blasting operations within 25 feet of the top of bank of a stream, within railroad rights-of-way, or within rights-of-way where blasting is prohibited by the governing agency.

E. Cover all shots with blasting mats to prevent flying material.

3.05 DISPOSAL OF EXCAVATED MATERIAL

A. Satisfactorily dispose of all excess excavated material that cannot be used for or is not suitable for embankments. The Owner is not responsible for disposed material in any regard including any possible regulatory action by local, state, or federal agencies.

3.06 UNAUTHORIZED EXCAVATION

A. Unauthorized Excavation will be defined as an excavation outside or below the proposed lines and grades shown on the Plans or directed by the Engineer.

B. Backfill areas of Unauthorized Excavation with the type material necessary (earth, rock, or concrete) to insure the stability of the structure of construction involved.

C. Unauthorized Excavation or backfill to replace same shall not be a pay item.

3.07 REMOVAL OF WATER

A. Keep excavated areas free of water while work is in progress.

B. Well pointing shall be performed if required.

C. Take particular precautions to prevent the displacement of structures or pipelines as a result of accumulated water.
3.08 OBSTRUCTIONS

A. Obstructions shown on the Plans are for information only and do not guarantee their exact locations nor that other obstructions are not present.

B. When utilities or obstructions are not shown on the Plans but are present at the location of the proposed pipeline route, the Contractor may request to relocate the proposed pipeline if necessary to avoid disturbing the utility or obstructions.

C. If the pipeline relocation is approved, the Contractor shall receive compensation for additional materials required for the relocation as measured and paid for under Section 01 50 00 Measurement and Payment.

D. Exercise due care in excavating adjacent to existing obstructions and do not disturb same unless absolutely necessary.

E. In the event obstructions are disturbed, repair or replace as quickly as possible to the condition existing prior to their disturbance. This repair or replacement will not be a pay item.

F. If desired by the utility company, pay for the repair or replacement work performed by the forces of the utility company or other appropriate party.

G. If replacement or repair of disturbed obstructions is not performed after a reasonable period of time, the Owner may have the necessary work done and deduct the cost of same from payments to the Contractor.

3.09 STORM SEWER BEDDING

A. Use Class A, B, or C bedding, whichever is shown on the Plans. If not shown, use Class C bedding.

B. Construct Class B bedding in a trench cut in natural ground or compacted embankment.
   1. Bed pipe on 6" of Class B material and sufficient additional Class B material accurately shaped by a template to fit the lower part of the pipe exterior.
   2. Ram and tamp in layers not over 6" in loose thickness around the pipe to a minimum depth of that shown on the Plans.
   3. When bell and spigot pipe is to be placed, dig recesses in the bedding material of sufficient width and depth to accommodate the bell.

C. Construct Class C bedding in a shallow trench.
   1. Shape the bedding to fit the lower pipe exterior for the specified embedment.
   2. When bell and spigot pipe is to be placed, dig recesses of sufficient width and depth to accommodate the bell.

3.10 SANITARY SEWER BEDDING

A. Always maintain proper grade and alignment during the bedding and tamping process.
   1. Any pipe dislodged during this process shall be replaced by the Contractor at his expense.
   2. Dig bell holes to assure uniform support of the pipe.

B. Bedding for PVC, DIP, and CCF RPM sewers:
   1. Completely encapsulate each sewer pipe section with granular material from a distance of 6" below the bottom of the pipe to a distance of 6" above the top of the pipe for the entire width of the ditch, compacted to 60% relative density, ASTM D-2049.
   2. Use Class I angular material.

3.11 BEDDING FOR WATER LINES
A. Always maintain proper grade and alignment during the bedding and tamping process.
   1. Any pipe dislodged during this process shall be replaced by the Contractor at his expense.
   2. Dig bell holes to assure uniform support of the pipe.
   3. Excavate the trench in such a manner as to form a suitable bed on which to place the pipe.

B. Bedding for PVC waterlines:
   1. Completely encapsulate each sewer pipe section with granular material from a distance of
      6" below the bottom of the pipe to a distance of 6" above the top of the pipe for the entire
      width of the ditch, compacted to 60% relative density, ASTM D-2049.
   2. For PVC water pipe, use Class I angular material.

C. Bedding for ductile iron waterlines:
   1. Lay each sewer pipe section on a 6" bed of granular material and backfill to the springline
      with granular material, compacted to 60% relative density, ASTM D-2049.
   2. In unimproved areas, use Class I or II granular material.
   3. In improved areas, use Class I angular material.

3.12 INITIAL BACKFILLING

A. Do not begin backfilling before the Owner has inspected the grade and alignment of the pipe, the
   bedding of the pipe, and the joints between the pipes. If backfill material is placed over the pipe
   before an inspection is made, reopen the trench in order for an inspection to be made.

B. Perform backfilling by hand, together with tamping, until fill has progressed to 18" above the top
   of the pipe.
   1. Deposit Class I granular material (where required) or loose soil free from lumps, clods,
      frozen material, or stones in layers approximately 6" thick.
   2. Compact by hand, or with manually operated machine tampers actuated by compressed
      air or other suitable means.
   3. Use tamps and machines of a suitable type which do not crush or otherwise damage the
      pipe.

3.13 FINAL BACKFILLING

A. After the backfill has reached a point 18" or more above the top of the pipe, perform final
   backfilling depending upon the location of the work and danger from subsequent settlement.

B. Backfilling in unimproved areas.
   1. Dispose of and replace all soft or yielding material that is unsuitable for trench backfilling
      with suitable material.
   2. Deposit backfill to the surface of the ground by dragline, bulldozer, or other suitable
      equipment in such a manner so as not to disturb the pipe.
   3. Neatly round sufficient surplus excavated material over the trench to compensate for after
      settlement.
   4. Dispose of all surplus excavated material.
   5. Prior to final acceptance, remove all mounds to the elevation of the surrounding terrain.

C. Backfilling beneath driveways and streets where nonrigid and rigid type surfacing is to be replaced.
   1. Use Class I granular material of either crushed limestone or crushed gravel of high weight
      and density.
   2. Carefully deposit in uniform layers, not to exceed 6" thick, compacted to at least 95
      percent standard proctor but not less than a minimum of 90 lb/ft3 dry density.
3. Compact each layer thoroughly by rolling, ramming, and tamping with tools suitable for that purpose in such a manner so as to not disturb the pipe.

D. Backfilling of shoulders along streets and highways.
   1. Backfilling methods and materials for shoulders along streets and highways shall be in accordance with the requirements of governing local, county, or state departments maintaining the particular roadway or highway.
   2. Replace with similar materials all shoulders that may be damaged or destroyed as a result of pipe trenching.
   3. Backfilling of shoulders shall not be directly measured for payment unless traffic whips out the shoulder material rather than settling it, then any additional crushed stone placed shall be paid for as crushed stone for shoulder replacement.
   4. Where shoulders along state highways have seal coat surfaces, replace with double bituminous seal in accordance with Section 32 12 00.
   5. Where the Virginia Department of Transportation or local authority requires trenches to be backfilled entirely with granular material in the shoulder of roads, granular material so placed shall not be a pay item but included in the prices per linear foot of pipe.

E. Crushed stone for pavement maintenance and shoulder replacement.
   1. Where possible, salvage and reuse all base material that is removed during construction.
   2. Wet and thoroughly compact crushed stone and blade to tie into the existing surface prior to final acceptance.
   3. Base material placed as a portion of pavement replacing items will not be directly measured for payment unless traffic whips out the base material rather than settling it, then any additional base material placed shall be paid for as crushed stone for pavement maintenance.

END OF SECTION 31 23 00
SECTION 31 31 16 – TERMITE CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Soil treatment with termiticide.

B. Related Sections:
   1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions and Sections in Division 01 of these Specifications.
   2. Division 03 Section “Cast-In-Place Concrete”.
   3. Division 06 Section "Rough Carpentry" for wood preservative treatment by pressure process.
   4. Division 07 Section “Vapor Barrier / Retarder” (Concrete Slabs On Grade).

1.3 SUBMITTALS

A. Comply with pertinent provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: For each type of termite control product.
   1. Include the EPA-Registered Label for termiticide products.

C. Qualification Data: For qualified Installer.

D. Product Certificates: For termite control products, from manufacturer.

E. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:
   1. Date and time of application.
   2. Moisture content of soil before application.
   3. Termiticide brand name and manufacturer.
   4. Quantity of undiluted termiticide used.
   5. Dilutions, methods, volumes used, and rates of application.
   6. Areas of application.
   7. Water source for application.

F. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE
A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located, and who employs workers trained and approved by manufacturer to install manufacturer's products, and who is accredited by manufacturer.

B. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.

C. Source Limitations: Obtain termite control products from single source from single manufacturer.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.

B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.6 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites and agreeing to make an inspection of the Work once each year for a total period of five years following Date of Substantial Completion for the purpose of detecting termite infestation. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation at no additional cost to the Owner.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. BASF Corporation, Agricultural Products; Termidor.
   b. Bayer Environmental Science; Premise 75.
   c. FMC Corporation, Agricultural Products Group; Dragnet or Talstar.

2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.
3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termitecide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termitecide manufacturer.
   1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termitecide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termitecide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticial barrier or treated zone is established around and under building construction. Distribute treatment evenly.
   1. Slabs-on-Grade and Basement Slabs: Underground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials only after all preparation for slab placement is complete and before concrete footings and slabs are placed.
   2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
   3. Walls: Apply treatment along both sides of all foundations walls, cross walls, and grade beams, after all nearby excavation has been completed. Apply treatment to voids in masonry walls below grade.
   4. Crawlspace: Soil under and adjacent to foundations as previously indicated. Treat adjacent areas including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
   5. Masonry: Treat voids.
   6. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.
   7. Utility entrances below grade: Apply treatment in utility trenches at locations such as where utilities pass through exterior walls and through floor slabs. Extend treatment not less than 48" in trench on exterior side of wall. Do not apply treatment in potable water line trenches.
8. Miscellaneous: Apply treatment at the following areas:
   a. Immediately below expansion joints, control joints, and all areas where slab will be penetrated by construction features.
   b. Where exterior facings or veneers extend below grade level along the exterior side of all foundation walls.
   c. Where unit masonry foundation construction is used.

B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

D. Post warning signs in areas of application.

E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

F. Coordinate the work of other trades to interface with the Work of this Section.

END OF SECTION 31 31 16
SECTION 32 11 00 - BASE COURSES

PART 1—GENERAL

1.01 WORK INCLUDED

A. Preparing and stabilizing subgrade to receive a base or pavement.
B. Placing and compacting base material.
C. Placing and compacting stabilized base.

1.02 RELATED WORK

A. Section 31 11 00: Clearing and Grubbing.
B. Section 31 20 00: Earth Moving.
C. Section 32 13 00: Rigid Paving. *Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction* (most current edition).

1.03 REFERENCE STANDARDS

A. Compact all subgrade materials to 100 percent of maximum density unless otherwise specified.
   1. Determine maximum density and optimum moisture in accordance with the “Standard Method of Test for Moisture Density Relationship of Soils Using a 5.5 Pound Rammer and a 12 inch Drop,” AASHTO Designation T-99, Method A.
B. Compact Type A Base materials to an average dry density of at least 100 percent of theoretical density based upon 83 percent of a solid volume, unless otherwise specified.
   1. No individual test shall be less than 97 percent of theoretical density.
   2. The theoretical density of limestone aggregates shall be based on bulk specific gravity AASHTO T-85.
   3. The theoretical density of all other aggregates shall be based on bulk specific gravity AASHTO T-84 and T-85.
C. Compact Type B base materials to at least 95 percent of maximum density, unless otherwise specified.
   1. No individual test shall be less than 92 percent of maximum density.
   2. Determine maximum density and optimum moisture in accordance with the “Standard Method of Test for Moisture Density Relationship of Soils Using a 5.5 Pound Rammer and a 12-inch Drop,” AASHTO Designation T-99, Method D.

PART 2—PRODUCTS

2.01 MINERAL AGGREGATE MATERIALS—GENERAL

A. Mineral aggregate: sound, tough, and durable fragments of crushed stone, crushed slag, crushed or uncrushed gravel or chert.
B. Fine aggregate: natural sand, silt-clay, or other inert materials with similar characteristics conforming to AASHTO M-6, M-29, and M-45 requirements except as specified herein.
C. Coarse aggregate: AASHTO M-43, except as specified herein, consisting of crushed stone, crushed slag, crushed or uncrushed gravel, crushed or uncrushed chert, or a combination thereof, or other inert materials with similar characteristics, having hard, strong, durable pieces free from adherent coatings.
D. Coarse aggregates: graded to standard sizes between the limits specified and to the gradation requirements set forth in the following table:

**SIZES OF COARSE AGGREGATE – AASHTO M-43**

<table>
<thead>
<tr>
<th>Size Number</th>
<th>Nominal Size Square Openings (1)</th>
<th>Amounts Finer Than Each Laboratory Sieve (Square Openings), Percentage By Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>3 ½ to 1 ½</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>1 ½ to 1</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>1 to 1</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>1 ½ to 1 ½</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>1 to 1 ½</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>1 ½ to 3/8</td>
<td>100</td>
</tr>
<tr>
<td>7</td>
<td>1 to 3/8</td>
<td>100</td>
</tr>
<tr>
<td>8</td>
<td>3/8 to No. 8</td>
<td>100</td>
</tr>
</tbody>
</table>

**BASE COURSES**
2.02 SUBGRADE STABILIZATION MATERIAL

A. Thoroughly pulverize and mix all subgrade and aggregate material until not more than five percent of the material exclusive of gravel or stone is retained on a two-inch sieve.

B. Add sufficient water during the mixing and compacting operation to provide optimum moisture content, as determined by AASHTO T-99, plus or minus three percentage points.

2.03 MINERAL AGGREGATE BASE MATERIALS

A. Base aggregates shall conform to the requirements of article 2.01 and shall be either Type A or Type B as shown on the Plans.

B. Base aggregate gradations:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2&quot;</td>
<td>100</td>
</tr>
<tr>
<td>1&quot;</td>
<td>90-100</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>40-65</td>
</tr>
<tr>
<td>No. 100</td>
<td>4-15</td>
</tr>
<tr>
<td>Sieve Size</td>
<td>Percent Passing by Weight</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>100</td>
</tr>
<tr>
<td>1&quot;</td>
<td>60-95</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>50-80</td>
</tr>
<tr>
<td>No. 4</td>
<td>40-65</td>
</tr>
<tr>
<td>No. 16</td>
<td>20-40</td>
</tr>
<tr>
<td>No. 100</td>
<td>9-18</td>
</tr>
</tbody>
</table>

C. Type A aggregate: crushed stone, crushed slag, crushed gravel, or crushed chert, and other fine-grained mineral matter.
1. Crushed stone: free from adherent coatings, clay, or other soils with wear not exceeding 50 percent and sodium sulphate soundness loss not exceeding 15 percent.
2. Crushed slag: quality as for crushed stone having a uniform density.
3. Crushed gravel and chert: screened and all oversize material crushed and fed back over the screen in a uniform manner.
4. Coarse aggregate wear for those retained on the No. 4 sieve shall not exceed 30 percent.
5. Material passing the No. 40 sieve: nonplastic, or with a liquid limit not exceeding 25 and a plasticity index not exceeding 6.
6. Only grading D aggregate shall be used.

D. Type B aggregate: crushed stone, crushed slag, crushed or uncrushed gravel, crushed or uncrushed chert, or a combination of these materials, and other fine grained material. The quality of Type B aggregate shall be the same as for Type A aggregate except as follows:
1. Gravel or chert: screened and the oversize material wasted or crushed and blended in a uniform manner with the remainder of the material.
2. Gravel or chert: no more than 12 percent clay.
3. Coarse aggregate wear for those retained on the No. 4 sieve shall not exceed 40 percent.
4. Additional binder or mineral aggregate may be incorporated into the material to meet gradation, density, or bonding requirements.
5. Grading C or D shall be used.

E. Furnish test reports on quality of all aggregates for approval by the Engineer prior to blending or mixing. If requested by the Engineer, furnish samples for testing by an independent laboratory. Test methods for aggregate base quality shall be by the following AASHTO methods:

<table>
<thead>
<tr>
<th>Test</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling</td>
<td>T-2-91</td>
</tr>
<tr>
<td>Percentage of wear</td>
<td>T-96-02</td>
</tr>
<tr>
<td>Soundness</td>
<td>T-104-99</td>
</tr>
<tr>
<td>Unit weight</td>
<td>T-19/M-00</td>
</tr>
<tr>
<td>Sieve analysis</td>
<td>T-27-99</td>
</tr>
</tbody>
</table>

2.04 CEMENT STABILIZED BASE MATERIALS

A. The Engineer will determine the proportions of materials to be used that will produce a workable lean concrete.
2. Minimum compressive strength of 500 psi in seven days.
3. Cement content of 200 pounds per cubic yard of concrete.
4. Maximum entrained air of five percent.
5. Water reducer quantity as recommended by the manufacturer.
6. Other applicable requirements as stipulated in Section 32 11 00.

PART 3—EXECUTION

3.01 PREPARATION

A. Clear construction areas as stipulated in Section 31 20 00.
B. Maintain benchmarks, monuments, and other reference points.

3.02 SUBGRADE PREPARATION

A. Prepare subgrade in reasonably close conformity with the lines and grades as shown on the Drawings or as designated by Engineer.
B. Haul, spread, and compact suitable material in sufficient quantity when the roadbed is below grade.
C. Prepare subgrade across the entire sub base section when sub-bases are to be constructed on the subgrade.
D. Construct subgrade 12” wider on each side of the base or pavement when forms are required for the base or pavement.
E. Clear subgrades, as stipulated in Section 31 11 00, required reworking to the limits described above.
F. Grade subgrade in such a manner as to provide ready drainage of water from subgrade. Maintain ditches and drains during construction.

3.03 SUBGRADE COMPACTION

A. Compact the finished subgrade to not less than 100 percent of the maximum density.
B. When the density requirement is not met, loosen the subgrade by discing, harrowing, or other approved methods to a depth of not less than six inches, then reshape and recompact.
C. Moisten and aerate the subgrade material as necessary during mixing and compacting to provide optimum moisture content.
D. Rework or remove, replace, and recompact all soft, yielding material, that will not compact readily.
E. Protect subgrade from damage and limit hauling over the finished subgrade to that which is essential for construction purposes.
F. Smooth and recompact all ruts or rough places that develop in a completed subgrade.
G. Check the lines, cross sections, and grades of the subgrade as completed for reasonably close conformity with those shown on the Drawings for the bottom of the sub-base or pavement or with those established by Engineer.

3.04 SUBGRADE STABILIZATION

A. Add and incorporate granular stabilizing material, with or without additives as required, into the existing subgrade.
B. Replace unsuitable subgrade material with stabilizing material in reasonably close conformity to the widths and depths shown on the Drawings or as directed by the Engineer.
C. Spread the quantity of aggregate for subgrade treatment, as designated on the Drawings or as directed, by means of a mechanical spreader, and thoroughly mix with the subgrade material by
means of a mechanical mixer. Spreading and mixing may be performed by other approved methods on short sections to be established, when permitted by the Engineer.

D. Spread material uniformly by motor grader to the required cross section and compact. Accompany compaction operations with sufficient blading by motor graders to assure a smooth, uniform surface.

E. Maintain the complete subgrade until covered by the following stage of construction or until the project has been completed and accepted.

3.05 PLACING AGGREGATE BASE

A. Place one or more courses of aggregates and additives if required, on a prepared subgrade in reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the Drawings or established by the Engineer.

B. Construct mineral aggregate base in one or more layers with a compacted thickness as shown on the Drawings.

C. The subgrade shall be checked and approved by the Engineer at least 500 feet in advance of spreading any mineral aggregate. This distance may be shortened by permission of the Engineer to as little as 200 feet between November 1 and April 1 or during periods of prolonged wet weather.

D. Mineral aggregate bases shall not be spread on a subgrade that is frozen or contains frost.

E. Hauling over material already placed will not be permitted until it has been spread, mixed, shaped, and compacted to the required density.

3.06 MIXING AND SPREADING AGGREGATE BASE

Unless otherwise specified, mix and spread base course materials, including additives if required on the Drawings. Furnish sieve analyses of mix gradations for all materials for approval by Engineer prior to beginning work. Methods of sampling and testing shall be in accordance with current AASHTO requirements.

A. Stationary Plant Method—For Type A or B base materials.
   1. Mix and add water in an approved stationary mixing plant capable of producing a well-graded mix.
   2. Add water and calcium or sodium chloride, if specified, during the mixing operation in the amount necessary to provide moisture content satisfactory for compacting.
   3. If combining of materials is required to meet the grading requirements, blend prior to mixing by uniformly adding the materials. Blending of materials in stockpiles will not be permitted.
   4. All material fed into the plant shall travel the full length of the pugmill.
   5. After mixing, transport the material for each layer of base to the job site while it contains the proper moisture content, and spread to the required thickness and cross section by means of an approved mechanical spreader.
   6. Test samples may be taken from the conveyor feeding the mixer or from the mixer output.

B. Road Mix Method (Mechanical Mixer)—For Type B base materials.
   1. Place the material for each layer of base course through an aggregate spreader or window-sizing device capable of being adjusted to spread the materials in the proper proportions.
   2. After placing, mix the material with an approved mechanical mixing machine of rotary or pugmill type capable of producing a uniform blend.
   3. During mixing, add water in the amount sufficient to provide moisture content satisfactory
for compacting.

4. If two or more materials are to be blended on the road, spread each material separately in the necessary proportions prior to blending and mixing, unless moisture control additives are specified.

5. If two or more materials are blended, test samples shall be taken after mixing and before compaction. If blending is not required, test samples may be taken from plant production or stockpiles.

C. Road Mix Method (Motor Grader)—For Type B base materials.

1. After depositing and uniformly spreading the material for each layer of base course, sprinkle it with water in sufficient quantity to moisten all particles, but not in such quantity that segregation of sizes or softening of the subgrade will occur.

2. Immediately following the application of water, thoroughly mix the material by windrowing and spreading with motor graders until the mixture is uniform throughout, unless moisture control additives are specified or if two or more materials are to be blended.

3. Spread the base material while at optimum moisture content in layers of specific thickness and cross section by means of approved motor graders.

4. If the required compacted depth of the base course exceeds 6", construct the base in two or more layers of approximate equal thickness. The maximum compacted thickness of any one layer shall not exceed 6" except when vibrating or other approved types of special compacting equipment are used. The compacted depth of a single layer of the base course may be increased to 8" upon approval of Engineer.

5. Immediately following spreading, shape the base material to the required degree of uniformity and smoothness.

6. Compact to the required density prior to any appreciable evaporation of surface moisture. Continuously compact each layer until the minimum density requirement is achieved.

7. Test samples may be taken from stockpiles or plant production.

3.07 COMPACTING AGGREGATE BASES

A. For compaction testing purposes, each completed layer will be divided into lots of approximately 10,000 square yards. Smaller lots may be considered when approved by the Engineer.

B. Five density tests will be performed on each lot and the results averaged.

3.08 PLACING CEMENT STABILIZED BASE

A. Construct a base of lean concrete on a prepared subgrade or sub-base in reasonably close conformity with the lines, grades, thickness, and typical cross section shown on the Drawings or as directed by the Engineer. Unless otherwise specified, construction shall be performed in accordance with the applicable requirements of Section 32 13 00.

B. Offset longitudinal joints 1' from the Portland cement concrete pavement joint with the 1' offset located on the median half of the lean concrete base.

C. Form a butt type joint, as directed by the Engineer, at the end of each day’s operation or when there is an interruption of paving operations.

D. Consolidate by the use of vibratory equipment.

E. Finish the surface to a uniformly closed texture. After strike-off and consolidation, no additional finishing will be required except that needed to maintain grade alignment and provide the close texture.

F. Insure that the lean concrete base grade alignment is such that Portland cement concrete pavement thickness is not deficient.

G. Reconstruct or replace, at no expense to Owner, bases with back thicknesses not within 1/2" of
those shown on the Drawings.

H. Do not place Portland cement concrete pavement upon the base until the mixture has cured for seven days.

END OF SECTION 32 11 00
SECTION 32 12 00 - FLEXIBLE PAVING

PART 1—GENERAL

1.01 WORK INCLUDED

A. Mixing, spreading, compacting, and finishing of bituminous pavements for base, leveling, and surface courses on roads, parking lots, and other areas.

B. Where specifically indicated on the Plans, asphalt paving shall conform to Tennessee Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition, as applicable. Otherwise, asphalt repaving shall conform to the specifications included herein.

1.02 RELATED WORK

A. Section 31 11 00: Clearing and Grubbing.

B. Section 31 20 00: Earth Moving.

C. Section 32 11 00: Base Courses.

D. Section 32 17 23: Pavement Marking.

PART 2—PRODUCTS

2.01 GENERAL REQUIREMENTS FOR ALL MIXES

A. Mineral Aggregate shall meet the general requirements of Section 32 11 00 and additional requirements specified for each type paving mixture.

B. Furnish test reports for aggregate and bituminous materials to be approved for quality by the Engineer prior to incorporation into the mix.

C. The Engineer may require samples of aggregate, bituminous materials, or the plant-mixed material for testing in an independent laboratory.

D. All methods of sampling and testing will be in accordance with current AASHTO methods for use on highway materials.

E. Submit a job-mix formula for approval by the Engineer for each mix to be used on the project to establish
   1. Percentage of each size aggregate to be used in the mix.
   2. Percentage of bituminous material.
   3. Discharge temperature of the mix.

F. The job-mix formula shall be within the range established for each type mix with allowable tolerances as follows:
   Aggregate passing 3/8" sieve and larger...........................................± 7%
   Aggregate passing No. 4 sieve and larger...........................................± 5%
   Aggregate passing No. 8 to No. 5 sieves...........................................± 4%
   Aggregate passing No. 100 to No. 200 sieves....................................± 2%
   Bitumen..................................................................................................± 0.4%
   Temperature of mix................................................................................± 20 degrees F.

G. Submit a new job-mix formula if a change in materials is made or if an unsatisfactory mixture results.

H. Bituminous mixing plants, either batch or continuous, sufficiently equipped and coordinated to provide paving mixes in an amount necessary for orderly prosecution of the work and to
   1. Produce a uniform mixture having complete and uniform coating of all aggregate and a uniform distribution of the bituminous material in the mix.
2. A canvas-cover, or cover of suitable material, to protect the mix during transit.
3. Insulation, if required, so that the mix can be delivered to the paving machine at the specified
temperature or not more than 25 degrees F. less than the discharge temperature at the plant.

I. Do not produce bituminous mixed material when the surface on which the material to be placed
is wet or otherwise unsuitable, the air temperature is below 40 degrees F., or when other
conditions would prevent the proper placing and compacting of the mix.

2.02 GENERAL REQUIREMENTS—HOT MIX PAVEMENTS

A. Conform to Article 2.01.
B. Hot mix ingredients: fine and coarse aggregate, chemical additive (if required), fill (if required),
and asphalt cement of penetration grade 60-7 or 85-100 meeting the requirements of AASHTO
M-20 for the grade used.
C. Chemical additive: heat-stable, antistripping containing no ingredient harmful to or altering the
characteristics of the bituminous material. Use the percentage of additive recommended by
the manufacturer.
D. Hot Mix Plant
1. Storage tanks capable of heating and maintaining the bituminous material at a uniform
temperature between 275 and 325 degrees F. before being introduced into the mixer.
2. Heat and dry aggregates to a uniform temperature between 225 and 325 degrees F. without
damaging or contaminating the aggregate.
3. For batch plants, include a means of accurately weighing each size aggregate and the
bituminous material. Use platform truck scales at continuous mixing plants.
4. Use twin pugmill type mixers that adequately heat and produce a uniform mixture with a
temperature of not less than 275 degrees F. at the time it is discharged from the mixer. In the
case of aggregates containing absorbed moisture causing boiling or foaming, the discharge
temperature may be reduced to 225 degrees F.
5. Mixing time: batch plants—as required to produce a uniform nonsegregated mix that is
satisfactory to the Engineer; continuous mixing plants—as determined by current
AASHTO requirements.

2.03 HOT MIX BASE

A. Conform to Articles 2.01 and 2.02.
B. Coarse aggregate (retained on the No. 4 sieve): crushed stone, crushed slag, crushed gravel, or
a combination of these materials with a sodium sulphate soundness loss not exceeding
nine percent and no crushed slag containing more than 20 percent, by weight, of glassy particles.
C. Fine aggregate: crushed stone or crushed slab, stockpiled separately from the coarse aggregate
with sodium sulphate soundness loss not exceeding 15 percent.
D. Combined coarse and fine aggregate grading:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing By Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot;</td>
<td>100</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>75-100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>45-70</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>30-55</td>
</tr>
<tr>
<td>No. 4</td>
<td>20-40</td>
</tr>
<tr>
<td>No. 8</td>
<td>10-30</td>
</tr>
<tr>
<td>No. 30</td>
<td>5-20</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-8</td>
</tr>
</tbody>
</table>
E. Proportions, by weight, of the total mixture:

Mineral Aggregate...........94.0 to 97.5%
Asphalt Cement.............. 2.5 to  6.0%

2.04 HOT MIX BINDER

A. Conform to Articles 2.01 and 2.02.
B. Coarse aggregate (retained on the No. 4 sieve): crushed stone, crushed slag, crushed gravel, or a combination of these materials with a sodium sulphate soundness loss not exceeding nine percent and no crushed slag containing more than 20 percent, by weight, of glassy particles.
C. Fine aggregate: natural sand, sand manufactured from stone gravel or slag, or a combination of these materials with a sodium sulphate soundness loss not exceeding 15 percent, and natural sand finer than 200 mesh not exceeding five percent.
D. Combined coarse and fine aggregate grading:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing By Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/2&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>65-90</td>
</tr>
<tr>
<td>No. 4</td>
<td>30-55</td>
</tr>
<tr>
<td>No. 8</td>
<td>20-45</td>
</tr>
<tr>
<td>No. 30</td>
<td>8-25</td>
</tr>
<tr>
<td>No. 100</td>
<td>1-12</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-7</td>
</tr>
</tbody>
</table>

E. The combination of aggregates and bitumen will be such that the mixture shall meet or exceed the stability requirements of the Virginia Department of Transportation Road and Bridge Standards (most current edition).

F. Proportions, by weight, of the total mixture:

Mineral Aggregate...........94.0 to 97.5%
Asphalt Cement.............. 2.5 to  6.0%

2.05 HOT MIX LEVELING COURSE

A. Conform to Articles 2.01 and 2.02.
B. Course Aggregate: as in Article 2.04, Hot Mix Binder.
C. Fine Aggregate: as in Article 2.04, Hot Mix Binder.
D. Combined coarse and fine aggregate grading:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing By Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>60-85</td>
</tr>
<tr>
<td>No. 8</td>
<td>20-40</td>
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<tr>
<td>No. 30</td>
<td>7-22</td>
</tr>
<tr>
<td>No. 100</td>
<td>1-12</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-8</td>
</tr>
</tbody>
</table>

E. Aggregate-bitumen combination: as in Article 2.04, Hot Mix Binder.
F. Mixture Proportions: as in Article 2.04, Hot Mix Binder.
2.06  HOT MIX ASPHALTIC CONCRETE (CRUSHED LIMESTONE)

A.  Conform to Articles 2.01 and 2.02.

B.  Coarse aggregate (retained on the No. 4 sieve): crushed limestone with a sodium sulphate soundness loss not exceeding nine percent, meeting AASHTO M-62 with the above exceptions.

C.  Fine aggregate: natural or manufactured sand with material finer than 200 mesh in natural sand not exceeding five percent, meeting ASTM D-1073, except

1.  When used on traffic lanes, use aggregate of not less than 50 percent crushed limestone and not more than 50 percent or less than 45 percent natural sand or sand manufactured from siliceous material.

2.  When used for non-traffic lane construction, aggregate may be composed entirely or in part of crushed limestone, but not more than 50 percent natural sand.

3.  When used for curb construction, the material passing the No. 200 sieve shall be 5-10 percent.

4.  Mineral filler, Portland cement, or limestone dust meeting the requirements of AASHTO M-17 shall be added to the mix, if required, to meet gradation requirements and shall be considered a part of the limestone percentage.

5.  Not more than five percent of the natural sand shall be retained on the No. 4 sieve.

D.  Combined coarse and fine aggregate grading:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing By Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>88-100</td>
</tr>
<tr>
<td>No. 4</td>
<td>56-80</td>
</tr>
<tr>
<td>No. 8</td>
<td>40-60</td>
</tr>
<tr>
<td>No. 30</td>
<td>18-38</td>
</tr>
<tr>
<td>No. 50</td>
<td>8-26</td>
</tr>
<tr>
<td>No. 100</td>
<td>5-15</td>
</tr>
<tr>
<td>No. 200</td>
<td>2-10</td>
</tr>
</tbody>
</table>

E.  Proportions, by weight, of the total mixture:

- Mineral Aggregate: 92.0 to 95.0%
- Asphalt Cement: 5.0 to 8.0%

2.07  HOT MIX ASPHALTIC CONCRETE (CRUSHED GRAVEL, SLAG, OR GRANITE)

A.  Conform to Articles 2.01 and 2.02.

B.  Treat asphalt cement with a heat-stable, anti-stripping additive blended at the terminal or at the mixing plant.

C.  Coarse aggregate (retained on the No. 4 sieve): meeting AASHTO M-62, except

1.  Sodium sulphate soundless loss not exceeding nine percent.

2.  Use crushed gravel of siliceous particles, processed from washed material; with at least 85 percent having one or more fractured faces.

3.  Use crushed slag with not more than 30 percent glassy particles.

4.  Do not use limestone or other aggregates tending to polish under traffic.

D.  Fine aggregate: natural sand, granite, screenings, slag screenings, or a combination of these materials, meeting ASTM D-1073, except

1.  When the combined aggregate includes crushed gravel or natural sand, use agricultural limestone in an amount of not less than 10 percent nor more than 20 percent of the aggregate, by weight.

2.  Agricultural limestone will also be permitted, as specified, in crushed slag or crushed granite.
aggregate if required to meet gradation requirements.

E. The combined coarse and fine aggregates, with the required amount of bitumen, will comply with the following Marshall test criteria:

- Minimum Stability: 1200 Pounds
- Void Content: 3-7%
- Flow: 8-15%

F. Mineral filler may be added, if required, in an amount not to exceed five percent of the aggregate, by weight.

G. Combined coarse and fine aggregate grading:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing By Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>88-100</td>
</tr>
<tr>
<td>No. 4</td>
<td>56-80</td>
</tr>
<tr>
<td>No. 8</td>
<td>40-60</td>
</tr>
<tr>
<td>No. 30</td>
<td>18-38</td>
</tr>
<tr>
<td>No. 50</td>
<td>8-26</td>
</tr>
<tr>
<td>No. 100</td>
<td>5-15</td>
</tr>
<tr>
<td>No. 200</td>
<td>2-10</td>
</tr>
</tbody>
</table>

2.08 HOT MIX LEVELING COURSE FOR WEARING SURFACE

A. Conform to Articles 2.01 and 2.02.

B. Coarse aggregate: crushed stone, crushed gravel, or crushed slag with
   1. Crushed gravel processed from washed material and consisting of siliceous particles, of which at least 50 percent of the material retained on the No. 4 sieve shall have one or more fractured faces.
   2. No uncrushed particles.
   3. The absorption of the gravel retained on the No. 4 sieve shall not exceed five percent when tested in accordance with AASHTO T-85.

C. Fine aggregate: natural sand, crushed slab sand, stone screenings, or agricultural limestone with
   1. When the coarse aggregate of the combined aggregate is crushed stone, use not less than 40 percent nor more than 50 percent, by weight, natural sand or crushed slag sand.
   2. When the crushed aggregate of the combined aggregate is crushed gravel or crushed slag, use not less than 15 percent nor more than 40 percent stone screenings or agricultural limestone.

D. The combination of aggregates and bitumen will be such that the mixture shall meet or exceed the stability requirements of the Virginia Department of Transportation Road and Bridge Standards (most current edition).

E. Combined coarse and fine aggregates grading:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing By Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4&quot;</td>
<td>100</td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>71-100</td>
</tr>
<tr>
<td>No. 8</td>
<td>40-70</td>
</tr>
<tr>
<td>No. 30</td>
<td>20-50</td>
</tr>
<tr>
<td>No. 100</td>
<td>2-12</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-8</td>
</tr>
</tbody>
</table>

F. Proportions, by weight, of the total mixture:
2.09 GENERAL REQUIREMENTS—COLD MIX PAVEMENTS

A. Conform to Article 2.01.
B. Cold mix ingredients: fine and coarse aggregates and emulsified asphalt, mixing grade AE-3.
C. Emulsified asphalt: homogeneous and of such stability that it will remain uniform while being mixed with dry aggregate. The emulsion shall thoroughly coat and adhere firmly to the surface of the mineral aggregate and show no signs of re-emulsifying after being incorporated into the work. The emulsion shall meet the following requirements.
1. Distillation to a temperature of 500 degrees F., not more than 30 percent distillate, by weight, with oil portion not more than 6% by volume.
2. Viscosity, saybolt-fural, 122 degrees F., sec. shall be 50 plus, and pumpable.
3. Settlement test at five days, not more than five percent (settlement shall be waived if the emulsion is manufactured and used in less than five days).
4. Stone coating test, at least 90 percent coated.
5. Tests on residue from distillation:
   a) Float test at 140 degrees F., not less than 200 sec.
   b) Ductility at 77 degrees F., not less than 40 cm.
   c) Solubility in CC14, not less than 97.5 percent.
   d) Ash by ignition, not more than two percent.
6. Base asphalt: show a negative result when tested with standard Naphtha Solvent.
7. Test emulsion in accordance with AASHTO T-59, except as follows:
   a) Spot test, AASHTO T-102.
   b) Solubility in CC14, AASHTO T-44.
   c) Float test, AASHTO T-50.
   d) Stone coating Test, AASHTO T-59, except mix the aggregate and emulsion for five minutes then drench with approximately twice its volume of tap water at room temperature.
D. Cold Mix Mixing Plant: meet the requirements of Article 2.01, except
   1. If the storage tanks for bituminous material are equipped to heat the material, the temperature of the bituminous material shall not exceed 180 degrees F. when combined with the aggregate.
   2. Dry the aggregate sufficiently to remove all surface moisture and heat to a temperature that will produce the discharge temperature of the mixture specified in the job-mix formula if the mixer is not heated. The temperature of the mixture shall not be less than 100 degrees F. nor more than 200 degrees F.
   3. Mixing time for both batch and continuous mixing plants shall be that required to produce a uniform, homogeneous mixture that is satisfactory to the Engineer.

2.10 COLD MIX BASE

A. Conform to Articles 2.01 and 2.09.
B. Aggregate: crushed stone or crushed slag, meeting AASHTO M-62, except
   1. Sodium sulphate soundness loss shall not exceed nine percent
   2. Crushed slag: not more than 20 percent by weight, of glassy particles.
   3. Produce in two fractions, separated on a 1-1/2” screen.
   4. Choker aggregate: crushed stone, crushed slag, or crushed gravel of size No. 68.
C. Combined aggregate size grading:
### 2.11 COLD MIX SURFACE COURSE

**A.** Conform to Articles 2.01 and 2.09.

**B.** The mix may be transported directly to the project site for spreading or may be stockpiled. Stockpiled material shall show no stripping or weather damage.

**C.** Aggregate: crushed stone or crushed slag meeting AASHTO M-63, except

1. Sodium sulphate soundness loss shall not exceed nine percent.
2. Crushed slag retained on the No. 4 sieve shall not contain more than 20 percent of glassy particles.
3. Aggregate for this mixture shall be Size No. 68.
4. Choker aggregate: size No. 8 of crushed stone, crushed slag, or crushed gravel.

**D.** Proportions, by weight, of total mixture:

- Mineral Aggregate: 93.0 to 95.0%
- Emulsified Asphalt: 5.0 to 7.0%

### 2.12 PRIME COAT

**A.** Bituminous material: emulsified asphalt or cutback asphalt.

**B.** Emulsified Asphalt, Grade AE-P:

<table>
<thead>
<tr>
<th>Test</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity, Furol at 77 degrees F.</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>Settlement at 5 days</td>
<td></td>
<td>5%</td>
</tr>
<tr>
<td>Sieve Test</td>
<td></td>
<td>0.10%</td>
</tr>
<tr>
<td>Distillation to 500 degrees F.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distillate, by weight</td>
<td></td>
<td>55%</td>
</tr>
<tr>
<td>Oil Portion of Distillate</td>
<td></td>
<td>12%</td>
</tr>
<tr>
<td>Tests on Residue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Float Test, 140 degrees F., Sec.</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Soluble in CC14</td>
<td></td>
<td>97.5%</td>
</tr>
</tbody>
</table>

The settlement test shall be waived if the emulsion is used in less than five days. The base asphalt shall show a negative result when tested by the spot test. The emulsion shall be tested in accordance with AASHTO T-59, except

2. Solubility in CC14, AASHTO T-44.

**C.** Cut-Back Asphalt: Grade RC-70 or RC-250 meeting the requirements of AASHTO M-81 for the grade specified or selected.

**D.** Application temperature for the bituminous material:
2.13 TACK COAT

A. Bituminous Material: emulsified asphalt or cutback asphalt.

B. Emulsified Asphalt:
   1. Grade SS-1, RS-1, and RS-2 meeting the requirements of AASHTO M-140 for the grade specified.
   2. Grade AE-3 shall meet the requirements of Article 2.09.

C. Cut-Back Asphalt: Grade RC-70 or RC-250 meeting the requirements of AASHTO M-81 for the grade specified or selected.

D. Application temperature for the bituminous materials:

   RC - 70........... 80 - 150 degrees F.
   RC - 250.......... 100 - 175 degrees F.
   SS - 1............. 60 - 140 degrees F.
   RS - 1............. 60 - 140 degrees F.
   RS - 2............. 60 - 140 degrees F.
   AE - 3............. 60 - 140 degrees F.

2.14 DOUBLE BITUMINOUS SURFACE TREATMENT

A. Double Bituminous Surface Treatment: bituminous mat composed of between 50 and 65 pounds per square yard of mineral aggregate bonded with bituminous material.

B. Bituminous Material: emulsified asphalt (AASHTO M-140), grade RS-2; or cutback asphalt (AASHTO M-81), grade RC 800 or RC 3000.

C. Mineral Aggregate: AASHTO M-43, except
   1. The sodium sulfate soundness loss shall not exceed nine percent.
   2. Crushed slag aggregate retained on the No. 4 sieve shall not contain more than 20 percent, by weight, of glassy particles.
   3. The amount of material finer than 200 mesh shall not exceed one percent.
   4. Testing may be required by the Engineer for bituminous film retention. When required, test in accordance with AASHTO T-182. Retention must be in excess of 95 percent or use a satisfactory chemical additive.
   5. Aggregate in mat: Size No. 6 and the aggregate used in the seal shall be size No. 7.

D. Application temperature ranges
   RC - 800.......... 175 - 250 degrees F.
   RC - 3000......... 200 - 275 degrees F.
   RS - 2............. 60 - 140 degrees F.

E. Only apply to a surface that is dry and clean, between April 1 and November 1 and when the air temperature is above 60 degrees F. in the shade.

F. Aggregate shall be approved by the Engineer based on test reports and sieve analysis to be furnished by the Contractor. The bituminous material shall be accepted based on laboratory analysis furnished with each shipment of material.

2.15 PARKING LOT SEALER
A. Parking lot sealer shall be SealMaster Coal Tar Concentrate Pavement Sealer or approved equivalent. (Phone: 800 395-7325; www.sealmaster.net)
B. Color: black
C. Sealer shall meet the requirements of ASTM D 5727, RP 355e and ASTM D 490.

PART 3—EXECUTION

3.01 PREPARATION

A. Construct bases and subgrades in conformance with Section 31 20 00.
B. Obtain approval of Engineer for the mix and surface to be treated prior to placing any materials.
C. Protect all adjacent trees, surfaces, and structures from the bituminous material during construction.
D. Prepare all receiving surfaces in reasonably close conformity with the lines, grades, and cross sections shown on the Drawings.

3.02 LIMITATIONS FOR HOT MIX PAVEMENT

A. Place bituminous plant mix only on an accepted subgrade.
B. The subgrade and the surface upon which the bituminous plant mix is placed shall be free of excessive moisture.
C. Place in accordance with the temperature limitations of the following table and only when weather conditions otherwise permit the pavement to be properly placed, compacted, and finished.

<table>
<thead>
<tr>
<th>Compacted Thickness</th>
<th>Minimum Placement Temperature, Air or Surface, whichever is less</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 1/2&quot;</td>
<td>50 degrees F.</td>
</tr>
<tr>
<td>1 1/2&quot; or more</td>
<td>40 degrees F.</td>
</tr>
</tbody>
</table>

3.03 MIXING HOT MIX PAVEMENTS

A. Measure and combine dried aggregates and the bituminous material within the mixer in the amount specified by the job-mix formula.
B. After the required materials have been introduced into the mixer, mix until a complete and uniform coating of the particles and a thorough distribution of the bituminous material throughout the aggregate are secured.
C. Wet-mixing time shall be determined by the Engineer for each plant and type of aggregate used, but in no case less than 25 seconds for batch plants and 40 seconds for continuous mix plants.
D. The temperature of the completed mixture (determined at the time it is dumped from the mixer) made with aggregates containing absorbed moisture which causes foaming or boiling shall be not less than 225 degrees F.
E. The temperature for grading A-S mixtures shall be between 225 and 275 degrees F.

3.04 SPREADING AND FINISHING HOT AND COLD MIX PAVEMENT

A. Deliver and spread bituminous mixtures in ample time to secure thorough compaction during daylight hours.
B. Deposit the mixture in the paver hopper within 25 degrees F. of the temperature at which it was discharged from the mixer.

C. Place the mixture upon an approved surface, spread, and strike-off to the established line, grade, and elevation by means of approved asphalt paving machines.

D. Echelon paving will not be permitted on two-lane projects where traffic is being maintained.

E. Control alignment of the outside edge of the pavement by preset control string lines.

F. For multicourse pavement, the longitudinal joint in one layer shall offset that in the layer immediately before by approximately one foot; for two lanes of width, the joint in the top layer shall be at the centerline or at lane lines if the roadway is more than two lanes in width.

G. Coordinate plant production and paving operations so that a uniform continuity of operation is maintained.

H. Use automatic screen controls of either the string line or ski type grade reference system on all work regardless of the paver width.
   1. The string line reference system may be required on new construction.
   2. If the base has been finished with equipment having automatic grade control or if the Contractor demonstrates that an alternate method of spreading and finishing will result in a satisfactory riding surface, the Engineer may conditionally waive the string line requirement and authorize use of the ski type reference system.
   3. The Engineer may at any time require the use of a string line reference system, even if previously waived, if the string line system will result in a superior riding surface.
   4. When the string line system is required on a multicourse pavement, use at least two courses exclusive of the surface course.
   5. For the ski type system, use the maximum practical length not less than 40 feet.
   6. Pavement lanes previously placed with automatic controls or to form grade may serve as longitudinal control reference for placing adjacent lanes by using a ski or joint matching shoe.

I. String line reference system: suitable wire or twine supported by approved devices compatible with the automatic paver control system.
   1. The string line and supports shall be capable of maintaining the line and grade designated by Plans at the point of support while withstanding the tensioning necessary to prevent sag in excess of 1/4" between supports spaced 50 feet apart.
   2. Install additional supports to provide a minimum spacing of 25 feet, or less as directed by the Engineer, to remove the apparent deviation of the string line from theoretical grade.
   3. Establish the reference system from the control points prescribed on the Plans.
   4. Maintain the reference system until its use is no longer required.
   5. The string line reference system shall be complete in place at least 300 feet in advance of the point where the pavement is being placed.

J. Automatic screen controls will not be required on sections where service connections or other conditions interfere with their efficient operation.

K. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, take the mixture from the hopper of the spreading machine and distribute immediately into place by means of suitable shovels and other tools and spread with rakes and lutes in a uniformly loose layer of such depth as will result in a completed course having the required thickness.

3.05 COMPACTATION OF HOT AND COLD MIX PAVEMENTS

A. After the bituminous mixture has been spread and stuck off, and surface irregularities adjusted, it shall be thoroughly compacted.

B. The method employed must be approved by the Engineer and be capable of compacting the mixture to the specified density while it is in a workable condition.
C. When no density requirements are specified, employ a system of compaction for roadway pavement that has previously produced required densities. A control strip and random density samples may be employed to aid the Engineer in evaluating the system.

D. Minimum roller requirements
   1. For each paver 16 feet wide or less use two rollers.
   2. For each paver 16 to 26 feet wide, use three rollers.
   3. For each paver 26 feet wide or more, use four rollers.
   4. Increase the number of rollers if the required results are not being obtained.

E. The minimum number of rollers listed above may, with the approval of the Engineer, be reduced to one roller of either the steel-wheel or vibratory type on the following types of construction:
   1. On shoulder construction.
   2. On incidental construction such as bridge approaches, driveways, etc.
   3. On projects containing less than 10,000 square yards of bituminous pavement.

F. Begin rolling at the low side and proceed longitudinally parallel to the road centerline.
   1. When paving in echelon or abutting a previously placed lane, roll the longitudinal joint first, followed by the regular rolling procedure.
   2. When paving in echelon, do not compact within six inches of an edge where an adjacent lane is to be placed.
   3. Roll at a slow, uniform speed with the drive wheels nearer the paver and keep as nearly as possible in continuous operation.
   4. Continue rolling until all roller marks are eliminated.

G. To prevent adhesion of the mixture to the rollers, properly moisten with water or water mixed with very small quantities of detergent or other approved material. An excess of liquid shall not be used.

H. Do not park or refuel rollers on the bituminous pavements.

3.06 REQUIRED DENSITY OF HOT MIX PAVEMENTS

A. Bituminous plant mix base, Gradings A and B (Black Base and Binder). An average of 90 percent of maximum theoretical density with no individual test less than 87 percent. Density requirements for these mixes will be waived if placed in lifts of two inches or less.

B. Bituminous plant mix base, Grading C (Leveling). Same as for Gradings A and B, except density requirements of this mix will be waived if placed in lifts of 1-1/4" or less.

C. Bituminous plant mix base, Grading C-W (Leveling-Wearing). An average density not less than 88 percent of maximum theoretical density with no individual test less than 85 percent. Density requirements on this mix will be waived if placed in lifts 1-1/4" or less.

D. Bituminous sand-gravel binder or surface course. An average of 85 percent of maximum theoretical density with no individual density test less than 82 percent.

E. Asphaltic concrete surface course, Grading D and E. An average of 93 percent of laboratory density as determined by the Marshall Method, 75 blow with no individual test less than 90 percent. When these mixes are used for shoulder construction, the average density shall not be less than 88 percent of maximum theoretical density with no individual test below 85 percent. Density requirements for these mixes will be waived if placed in lifts of one inch or less.

F. Asphaltic surface course, Grading F and sand-asphalt surface course. An average of 92 percent of laboratory density as determined by the two-inch Hubbard-Field Method with no individual density test less than 89. percent. Density requirements on this mix will be waived if placed in lifts of ¾" or less.

G. For density testing purposes, divide the pavement into lots of approximately 10,000 square yards, except for Grading "A" and "B" with lots of approximately 5,000 square yards. Perform five density tests in each lot and compare the average results with the requirements listed above.
3.07 JOINTS FOR HOT MIX PAVEMENTS

A. Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized by the Engineer.
B. Form transverse joints by cutting back on the previous run to expose the full depth of the course.
C. When directed by the Engineer, use a brush coat of bituminous material on contact surfaces of transverse joints just before additional mixture is placed against the previously rolled material.

3.08 SEPARATING COLD MIX AGGREGATES

A. Produce the aggregate for the bituminous mixtures in two fractions
   1. Separate Mix No. 1 on the 1-1/4", 1-1/2", or 1-3/4" screen.
   2. Separate Mix No. 2 on the 1" or 1-1/4" screen.

3.09 MIXING COLD MIX PAVEMENTS

A. Measure and combine the aggregate and the bituminous material within the mixer in the amount specified by the job-mix formula.
B. The temperature of the bituminous material shall not exceed 180 degrees F. when combined with the mineral aggregate.
C. Mix the materials until a complete and uniform coating of the aggregate particles and a thorough distribution of the bituminous material throughout the aggregate are secured.
D. The mixing time will be determined by the Engineer for each plant and type of aggregate used.
E. The temperature of the completed mixture, determined at the time it is dumped from the mixer, shall not be less than 110 degrees F. nor more than 200 degrees F.

3.10 PLACING PRIME COAT

A. Seasonal and temperature limitations for applying bituminous prime coat shall conform to the same requirements as those specified for the succeeding stage of construction except the prime may be applied to a surface that is slightly damp but not wet.
B. Apply bituminous material to the width of the section to be primed with a pressure distributor at a uniform, continuous spread.
C. Correct any areas containing an excess or deficiency of priming material by adding blotter material or bituminous material.
D. If, after the bituminous material has been applied, it fails to penetrate before the time that the roadway must be used by traffic, spread dry cover material between eight and 12 pounds per square yard to prevent damage to the primed surface. Avoid an excess of cover material.

3.11 PLACING TACK COAT

A. Immediately after cleaning the surface, apply bituminous material with a pressure distributor at a rate not exceeding 0.05 gallon of residual bitumen per square yard for all materials except asphalt cement.
B. For asphalt cement AC-20, apply at the rate of 0.05 to 0.10 gallons per square yard.
C. Allow the tacked surface to dry until it is in a proper condition to receive the next course.
D. Apply only so far in advance of the paving operations as is necessary to obtain the proper condition of tackiness.
E. Protect the tack coat from damage until the next course is placed.
3.12 DOUBLE BITUMINOUS SURFACE TREATMENT

A. Make the first application of bituminous material by pressure distributors at a uniform rate of between 0.38 and 0.42 gallons per square yard.
B. Each width of spread shall not be less than one-half the surface to be treated.
C. Before beginning each spread, lay building paper across roadway surfaces with the forward edge exactly coinciding with the end of the preceding covered spread.
D. Start distributors on the paper, the width of which shall be such that the full force of all nozzles shall be in effect before the forward edge of the paper is reached.
E. Correct all defects in any application at once.
F. Treat areas that are inaccessible to the distributor with either hand sprays or pouring pots.
G. If less than the full width of roadway is being treated, do not spread aggregate on the inside 6" of either the first or second application until the adjacent lane has been treated.
H. Immediately after each application, cover uniformly with Size No. 6 mineral aggregate reasonably free of surface moisture.
I. Spread the aggregate by self-propelled mechanical spreaders between 30 and 40 pounds per square yard. Back the truck on the aggregate being spread and not on or over uncovered bituminous material.
J. The length of spread of bituminous material shall not be in excess of that which trucks loaded with cover material can immediately cover.
K. Apply the second application of bituminous material in the same manner as the first application, at a uniform rate of between 0.30 and 0.35 gallon per square yard as established by the Engineer.
L. Spread mineral aggregate, Size No. 7, in the same manner as the first spread at a rate of 20 to 25 pounds per square yard.
M. Hand-broom each spread of cover aggregate for uniform coverage. Place additional aggregate by hand on thin or bare areas.
N. Roll the entire surface, beginning at the edges and progressing to the center, within 30 minutes after spreading. Initial rolling normally shall be done with a pneumatic tire roller, followed by steel-wheel rolling.
O. Allow the first application to cure for such length of time as deemed necessary before the second application is begun. Immediately before the second application of bituminous material, roll the surface with a steel-wheel roller.
P. Repeat the same rolling and curing procedures required in making the first application for the second application.
Q. Allow slow-moving traffic to use sections of the roadway where the bituminous material has been covered with mineral aggregate.

3.12 PARKING LOT SEALER

A. Verify that existing parking lot striping will accept sealer. If it will not, report finding immediately to the owner and Architect.
B. Comply with manufacturer’s recommendations.
C. Surface must be clean and free from all loose material and dirt. Pavement surface repairs should be made with a suitable hot or cold asphalt mix. Cracks should be filled with SealMaster hot pour or cold applied crack fillers. Treat all grease, oil and gasoline spots or stains with SealMaster Petro Seal™ or Prep Seal™.
D. Apply by either pressurized spray application equipment or self-propelled squeegee equipment. Pressurized spray equipment shall be capable of spraying pavement sealer with sand added. Equipment shall have continuous agitation or mixing capabilities to maintain homogeneous consistency of pavement sealer mixture throughout the application process. Self-propelled squeegee equipment
shall have at least 2 squeegee or brush devices (one behind the other) to assure adequate distribution and penetration of sealer into bituminous pavement. Hand squeegees and brushes shall be acceptable in areas where practicality prohibits the use of mechanized equipment.

E. Apply two coats of properly mixed Coal Tar sealer at a rate of 70–80 square feet per gallon per coat.
F. Both surface and ambient temperature shall be a minimum of 50°F. Temperature shall not drop below 50°F in a 24 hour period following application.

END OF SECTION 32 12 00
SECTION 32 17 23 - PAVEMENT MARKING

PART 1—GENERAL

1.01 WORK INCLUDED
   A. Marking of pavement, including surface preparation and painting on bituminous or concrete surfaces. Pavement and curb markings are commonly placed by using paints or thermoplastics.

1.02 ACCEPTANCE PROCEDURE
   A. Typical Sample analysis.
   B. Certification that paint meets requirements.

PART 2—PRODUCTS

2.01 PAINT
   A. Paint color shall be as indicated on the construction drawings and shall conform with the MUTCD.
   B. Drying time of three to five minutes when heated to application temperature.
   C. Each paint container shall be labeled showing details of paint, application procedure, and date of manufacture.

PART 3—EXECUTION

3.01 Perform pavement marking in accordance with the Manual on Uniform Traffic Control Devices for Streets and Highways published by FHWA.

3.02 Apply marking in strict accordance with the manufacturer’s recommendations, but with a minimum wet film thickness of 15 +/- 1 mils with six pounds of glass beads per gallon.

3.03 Mark pavement in close conformity to the lines, dimensions, patterns, locations, and details shown on the Drawings or established by the Engineer.

END OF SECTION 32 17 23
SECTION 32 31 21 ALUMINUM LOUVER FENCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Ornamental fixed louver modular fencing panels fabricated with extruded aluminum louvers and flat aluminum bars, including extruded aluminum fence posts.

B. Related sections:
   1. Section 03 30 00 - Cast-in-Place Concrete: Concrete footings for support of fence posts.

1.2 REFERENCES

A. ASTM International (ASTM):
   2. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
   3. ASTM B221 - Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   6. ASTM D3363 - Test Method for Film Hardness by Pencil Test.

1.3 SUBMITTALS

A. Provide in accordance with Section 01 33 00 - Submittal Procedures:
   1. Product data for components and accessories.
   2. Shop drawings showing layout, dimensions, spacing of components, and anchorage and installation details.
   3. Sample: 8 by 10 inches minimum size sample of fence panel illustrating design, fabrication workmanship, and selected color coating.
   4. Copy of warranty specified in Paragraph 1.4 for review by Architect.

1.4 WARRANTY

A. Provide in accordance with Section 01 77 70 - Closeout Procedures:
   1. 10-year warranty for factory finish against cracking, peeling, and blistering under normal use.

PART 2 - GENERAL

2.1 ACCEPTABLE MANUFACTURERS

A. Basis of Design: Ametco Manufacturing Corporation, 4326 Hamann Parkway, P.O. Box 1210, Willoughby, Ohio 44096; 800-382-1360.

B. Requests to use equivalent products of other manufacturers shall be submitted in accordance with Section 01 25 13 - Product Substitution Procedures.
2.2 MATERIALS

A. Extruded aluminum: ASTM B221, Alloy 6063, Temper T-6.
B. Sheet aluminum: ASTM B209, Alloy 6063, Temper T-6.
C. Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, and water-reducing and plasticizing additives.

2.3 FENCE SYSTEM

A. Type: Ornamental fencing system consisting of horizontal, fixed louver, modular fence panels fabricated with extruded aluminum framing bars and supported by extruded aluminum fence posts;
B. Basis of Design: Venetian Aluminum Fixed Louver Fencing as manufactured by Ametco Manufacturing Corporation.
C. Fence panel:
   1. Fixed louver bars: V-shaped extruded aluminum louver bars, 1-3/4 inches wide by 2-1/2 inches high, spaced at 2-5/8 inches and providing 100 percent direct visual screening.
   2. Framing bars: Extruded aluminum flat bars welded to ends of louver.
   3. Panel height: As indicated on Drawings.
   4. Panel width: As indicated on Drawings.
D. Posts:
   1. Type: 2 x 4 inch extruded tubular aluminum sections with solid aluminum caps.
   2. Length: As indicated on Drawings.

2.4 ACCESSORIES

A. Fasteners: Stainless steel bolts of type, size, and spacing as recommended by fence manufacturer for specific condition.

2.5 FACTORY FINISH

A. Aluminum fence panels and posts shall receive polyester powder coating.
B. Polyester powder coating: Electrostatically applied colored polyester powder coating heat cured to chemically bond finish to metal substrate.
   1. Minimum hardness measured in accordance with ASTM D3363: 2H.
   2. Direct impact resistance tested in accordance with ASTM D2794. Withstand 160 inch-pounds.
   3. Salt spray resistance tested in accordance with ASTM B117: No undercutting, rusting, or blistering after 500 hours in 5 percent salt spray at 95 degrees F and 95 percent relative humidity and after 1000 hours less than 3/16 inch undercutting.
C. Weatherability tested in accordance with ASTM D822: No film failure and 88 percent gloss retention after 1 year exposure in South Florida with test panels tilted at 45 degrees

PART 3 - EXECUTION
3.1 PREPARATION

A. Prior to fabrication, field verify required dimensions.

B. Cast concrete footings in accordance with Section 03 30 00 - Cast-in-Place Concrete as detailed on Drawings and approved shop drawings.
   1. Minimum footing diameter:
      a. Terminal and gate posts: 12 inches.
      b. Intermediate line posts: 12 inches.
   2. Allow 30 inches minimum embedment of posts.
   3. Allow 6 inches minimum concrete beneath post bottom.

C. Provide setting holes for embedment of fence posts. Hole shall be 2 inches minimum greater than post width.

3.2 INSTALLATION

A. Install fencing in accordance with manufacturer's installation instructions and approved shop drawings.

B. Install fence posts plumb and level by setting post in hole [cast] [drilled] in concrete and grouting solid. [by embedding post directly in concrete footing.] Temporarily brace fence posts with 2 by 4 wood supports until [concrete] [grout] is set.

C. Do not install bent, bowed, or otherwise damaged panels. Remove damaged components from site and replace.

D. Secure fence panels with standard stainless steel bolts to fence posts after posts have been set in footings.

E. Touch-up damaged finish with paint supplied by manufacturer and matching original coating.

END OF SECTION 08 38 00
SECTION 33 10 00 - WATER UTILITY DISTRIBUTION PIPING

PART 1—GENERAL

1.01 WORK INCLUDED
A. Installation, testing, and disinfection of water lines and appurtenances in accordance with the Tennessee Department of Environment and Conservation design criteria, with details shown on the approved Plans.
B. All waterline materials for potable water use shall be lead free in accordance with the Federal Reduction of Lead in Drinking Water Act effective January 4, 2014.

1.02 RELATED WORK
A. Section 31 23 00: Excavation and Fill.
B. Section 33 11 13: Separation of Piped Utilities.

PART 2—PRODUCTS

2.01 POLYVINYL CHLORIDE PIPE (PVC) AND FITTINGS
A. Provide PVC pipe meeting or AWWA C-900 for pipes smaller than 3 inches in diameter, unless otherwise specified in the Plans.
B. ASTM D-2241 Pipe:
   1. Manufactured from virgin, National Sanitation Foundation (NSF) approved Type 1, Grade 1 impact improved resin suitable for use in transporting potable water.
   2. Pipe and fittings pressure rated for 200 psi.
   3. Use only where the maximum pressure shall not exceed two-thirds of the pressure rating or 135 psi.
   5. Joints sealed with a rubber ring and nontoxic lubricant as provided by the manufacturer meeting or exceeding the requirements of ASTM D-3139 and ASTM F-477.
   6. Clearly mark with the manufacturer’s name, nominal diameter, SDR, ASTM D-2241, pressure rating, and NSF approved seal.
C. AWWA C-900 Pipe:
   1. PVC 1120 pipe manufactured from virgin, National Sanitation Foundation (NSF) approved compounds meeting the requirements of ASTM D-1784.
   2. Pressure rated based on dimension ratios (DR) and pressure classes (pressure classes are working pressure ratings):

<table>
<thead>
<tr>
<th>Dimension Ratio (DR)</th>
<th>Pressure Class (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>165</td>
</tr>
<tr>
<td>18</td>
<td>235</td>
</tr>
<tr>
<td>14</td>
<td>305</td>
</tr>
</tbody>
</table>

   3. Outside diameter equivalent to the same outside diameter of cast iron pipe.
   4. The minimum wall thickness of the bell, at any point, shall conform with the DR requirements of the pipe.
   5. Furnish in standard laying lengths of 20 feet.
   6. Clearly mark with the manufacturer’s name, nominal diameter, DR, PVC 1120, pressure
2.02 DUCTILE IRON PIPE AND FITTINGS

A. Provide Ductile Iron Pipe and fittings for pipes 3 inches in diameter and larger, unless otherwise specified on the Plans.

B. Pipe:
   1. Manufactured in accordance with ANSI A-21.50 (AWWA C-151) and ANSI A-21.10 9 (AWWA C-110).
   2. A cement lining meeting the requirements of ANSI 21.4 (AWWA C-104).
   3. A minimum of 1 mil thick bituminous coating on the outside surface.
   4. Clearly mark with manufacturer’s name, DI or ductile, weight, class or nominal thickness, and casting period.
   5. Unless otherwise specified or shown on the Plans, ductile iron pipe shall be Pressure Class 350 for 250 psi working pressure.

C. Fittings:
   1. Fittings up to 24": Pressure rated at 350 psi.
   2. Fittings 30”-36”: Pressure rated at 250 psi.
   4. All concreted fittings shall be wrapped in plastic.

2.03 SERVICE PIPE

A. Provide Type K Copper Pipe for pipes smaller than 3 inches in diameter, unless otherwise specified in the Plans:
   1. Seamless copper tubing meeting the requirements of ASTM B-88, Type K.
   2. Contain not less than 99.90% copper and not more than 0.04% phosphorous.
   3. Suitable for use with a working water pressure of 160 psi.
   4. 3/4" nominal diameter unless otherwise specified or shown on the Plans.
   5. Service pipe shall be used to connect the corporation stop with the meter yoke. Use the minimum length required to make a straight line connection including a gooseneck.
   6. Shall be manufactured in the USA.

2.04 WATER SERVICE ASSEMBLIES

A. Water Meters:
   1. AWWA C-700.
   2. 5/8” x 3/4” unless otherwise specified or shown on the Plans.
   3. Frost-proof with a cast bronze casing and a hinged cover.
   4. Direct reading register, in gallons, unless otherwise specified.
   5. Disc or piston operated with magnetic drive.
   6. A suitable noncorrosive strainer located over the inlet to the measuring chamber.
   7. Shall be manufactured by Badger or Neptune only. The name of the manufacturer shall be cast in the lid of the register box and the meter serial number imprinted thereon.
   8. Electronic reading (where specified): Registers shall have a receptacle that will allow electronic reading of the meter with a portable data acquisition unit. The receptacle shall be designed for mounting in the meter chamber lid. Meters must have encoder-type remote-registration conforming to the latest version of AWWA C707. Registers using
generator pulses or low voltage conversions are not permitted. Power requirement for data transmission must be supplied by an interrogation device. Registers must be compatible with various brands of interrogation equipment.

9. Remote electronic reading: In some circumstances it may be appropriate to install a low-power radio transmitter with the meter. This can be situated appropriately and read from a distance of up to 75 feet depending on local conditions. The radio simply takes the place of the lid receptacle. Meters must have encoder-type remote-registration conforming to the latest version of AWWA C707. Registers using generator pulses or low voltage conversions are not permitted. Power requirement for data transmission must be supplied by an interrogation device. Registers must be compatible with various brands of interrogation equipment.

B. Water Main Connections:
1. Tap water mains in the upper half of the pipe shall be at a 45 degree angle, or provide brass tapped couplings with AWWA threads.
2. Do not exceed the pipe manufacturer's recommended maximum tap size.
3. Use service clamps on all taps for PVC pipe.

C. Corporation Stops:
1. AWWA C-800.
2. Brass components in contact with potable water shall be of No-Lead Alloy.
3. Watertight and individually tested for leaks.
4. Waterway diameter approximately equal to the nominal size of the stop.
5. Coat or cap all threads for protection prior to installation.

D. Meter Yokes:
1. Copper tubing with an integral brace and meter stop.
2. Minimum rise of 15”.
3. Provide with outlets designed for the use of polyethylene or copper service pipe.
4. Shall be manufactured by Ford or equal, and shall be manufactured in USA.

E. Service clamps:
1. Bronze with neoprene gasket and double straps.
2. Shall be manufactured by Mueller, Rockwell, or Kennedy only.

F. Meter Boxes:
1. Rectangular precast concrete, cast iron, or plastic.
2. Precast concrete and cast iron meter boxes shall have a cast iron lid.
3. Depth of the meter box not less than 18”.
4. Of sufficient size to facilitate easy installation and removal of the water meter.
5. Where service assemblies include a pressure reducing valve, it shall be sufficiently sized for installation of the pressure reducing valve in the meter box.
6. Shall be Carson Industries 1419 with solid cast iron overlapping cover or equal, shall be manufactured in USA.

G. Pressure reducing valves for service assemblies:
1. Where the static pressure is greater than 80 psi, or as shown on the Plans, service assemblies shall include a pressure reducing valve and all necessary fittings and appurtenances.
2. Cast bronze body provided with a strainer on the inlet end.
3. 3/4” nominal size with factory preset delivery pressure of 45 psi and field adjustable without the use of special tools and without removing the valve from the line.
4. Locate in the meter box on the downstream side of the meter.

H. Reduced Pressure Zone and Enclosure:
1. Reduced Pressure Zone (RPZ) assembly shall be as shown on the construction drawings.
2. Enclosure for RPZ assembly shall be as shown on the construction drawings.
3. Concrete pad for RPZ assembly shall be as shown on the construction drawings.

2.05 VALVES AND VALVE BOXES

A. Gate Valves:
1. AWWA C-509 (resilient seat).
2. Valves shall be iron body, bronze mounted, nonrising stem type.
3. Stuffing boxes: O-ring seal type with two rings in the stem located above the thrust collar.
4. 2” square wrench nut for operation of the valve.
5. Minimum design working water pressure of 200 psi for valves with diameters 2”-24”, unless otherwise specified or shown on the Plans.
7. Bonnet or body markings: Manufacturer’s name, year of casting, size, pressure rating, and “open” with direction.
8. Open by counterclockwise operation, unless otherwise specified.

B. Butterfly Valves:
1. All valves 16” and larger shall be of the butterfly type.
2. AWWA C-504.
3. Cast iron body, with ends for mechanical joints, rubber molded-in-place seat design type.
4. Cast markings: valve size, manufacturer’s name, class, direction of opening, and the year of casting.
5. Class 250, suitable for working water pressure of 250 psi unless otherwise specified or shown on the Plans.
6. Open by counterclockwise operation, unless otherwise specified.
7. Valves shall be of the bury type with side operated spur gear box with a typical AWWA 2” operating nut.
8. Pratt “Groundhog” or equal. Shall be manufactured in USA.

C. Main Line Pressure Reducing Valves:
1. The reducing valve shall function to maintain a uniform valve downstream pressure as pre-adjusted on the control pilot hand-wheel or adjusting screw.
2. The valve piston shall be guided on its outside diameter by long stroke stationary Vee ports which shall be downstream of the seating surface to minimize the consequences of throttling. Throttling shall be done by the valve Vee ports and not the valve seating surfaces.
3. The valve shall be capable of operating in any position and shall incorporate only one flange cover at the valve top from which all internal parts shall be accessible.
4. The valve body shall be of cast iron ASTM-126 with flanges conforming to the latest ANSI Standards. The valve shall be extra heavy construction throughout. The valve interior trim shall be bronze B-62 as well as the main valve operation.
5. The valve seals shall be easily renewable. The valve shall operate by a pressure differential piston design; no diaphragm shall be permitted within the main valve body.
6. All controls and piping shall be non-corrosive construction.
7. A visual valve position indicator shall be provided for observing the valve piston position at any time.
8. The operating range shall be from 175 psi to 100 psi.
9. Golden Anderson or equal, shall be manufactured in USA.

D. Valve Boxes:
1. Cast iron, two- or three-piece, screw type with shaft diameter of not less than 5”.
2. Heavy roadway type equipped with a cover containing the word “WATER” in raised letters.
on the top.

3. Base of such size as to permit its installation without allowing it to come in contact with either the valve or the pipe.

4. Valve boxes for lines 12” and larger shall be 5-¼” shaft, 2 piece, screw-type, adjustable valve box with square drop-in lid with 1-½” skirt, as manufactured by Bingham & Taylor.

5. Valve boxes for lines smaller than 12” shall be 5-1/4” shaft, screw-type, series 6850 as manufactured by Tyler/Union.

2.06 AIR RELEASE ASSEMBLIES

A. Furnish in 1” nominal diameter for 8” mains and smaller and in 2” nominal diameter for 10” mains and larger, unless otherwise specified or shown on the Plans.

B. Air release assemblies shall consist of:
   1. Double strap, bronze service clamp with neoprene gasket (for PVC lines).
   2. Galvanized steel pipe of the nominal diameter required by the main size.
   3. Red brass corporation stop.
   5. Gate valve.
   6. Air release valve.

C. Combination air release valves consisting of:
   1. An air and vacuum valve coupled with an air release valve.
   2. Suitable for use in mains having a working pressure of 200 psi.
   3. Shall be single body.
   4. Shall be manufactured by A.R.I., Model D-040.

D. Install 2” air release valves in an 18” Jumbo XL meter box, and 1” air release valves in 18” diameter standard meter box.

E. Place crushed stone from the top of the main to 12” below the bottom of the main.

2.07 FIRE HYDRANTS, BLOW-OFF HYDRANTS AND YARD HYDRANTS

A. Fire Hydrants:
   1. AWWA C-502.
   2. Cast iron bodies, fully bronze mounted, designed for operation at a working water pressure of 150 psi.
   3. Furnish with two 2-1/2” threaded brass hose nozzles and one threaded brass pumper nozzle.
   4. Compression type main valve 5-1/4” or 4-1/2” in diameter faced with a suitable yielding material such as rubber, leather, or balata.
   5. So designed that when it is installed, no excavation is required to remove the main valve or the movable parts of the drain valve.
   6. Inside diameter of barrel: at least 120 percent of the hydrant valve size.
   7. Inlet connection: minimum of 6” mechanical joint on all lines, unless otherwise specified or shown on the Plans.
   8. Equipped with safety flange located not more than 2” above ground and a two piece shaft break-away assembly.
   9. Open on counterclockwise operation, unless otherwise specified.
   10. Shop paint and mark in accordance with AWWA C-502.
   11. Cast markings: manufacturer’s name, size of the main valve, year of manufacture, and
direction of opening.

12. Field touch-up, if the surface has been marred, with paint supplied by the manufacturer of the same color and type as that used during shop painting.

13. Shall be Kennedy KAD1-A Guardian as manufactured by the Kennedy Valve Company, or American Darling ADV MK 73 as manufactured by American Darling.

B. Blow-Off Hydrants:
1. Post type having cast iron bodies, fully bronze mounted and designed for operation at a working water pressure of 150 psi.
2. Furnish with either two 1-1/2” or one 2-1/2” threaded brass hose nozzle.
3. Compression type main valve 2-1/8” minimum diameter faced with a suitable yielding material such as rubber, leather, or balata.
4. Designed so that when it is installed, no excavation is required to remove the main valve or the movable parts of the drain valve.
5. Inside diameter of barrel: at least 3”.
6. Inlet connection: 2” mechanical joint, unless otherwise specified or shown on the Plans.
7. Equipped with a safety flange located not more than 2” above the ground.
8. Open on counterclockwise operation, unless otherwise specified.
9. Cast markings: manufacturer’s name, size of the main valve, year of manufacture, and direction of opening.
10. Field touch-up, if the surface has been marred, with paint supplied by the manufacturer of the same color and type as that used during shop painting.

A. Yard Hydrants:
1. Yard hydrant shall be as shown on the construction drawings.

2. PART 3—EXECUTION

3.01 PREPARATION

A. Supervision of Construction—One set of the plan document stamped “APPROVED FOR CONSTRUCTION” shall be available at the job site at all times during construction. The Engineer or a person qualified other than the Contractor or his representative and approved by the public water system shall provide continuous adequate inspection during construction to assure that all work is done in accordance with approved plan documents. The Department’s representative shall have access to the project at any time during construction. If the Department’s representative observes work being done in a manner that does not conform to the approved plan documents, he shall have the authority, through the Engineer’s representative, the water system’s agent or directly to the Contractor, to order the cessation of all work affected by the nonconformity until such discrepancies are rectified.

B. Prior to laying pipe, prepare a suitable bedding according to Section 31 23 00.

C. Before placing pipe in the trench, field inspect for cracks or other defects; remove defective pipe from the construction site.

D. Swab the interior of the pipe to remove all undesirable material.

E. Prepare the bell end and remove undesirable material from the gasket and gasket recess.

3.02 INSTALLING WATER LINES

A. Lay all pipe in a straight line on a uniform grade.

B. After applying gasket lubricant, take extreme care to keep the spigot end from contacting the ground.
C. Hone the pipe with suitable tools or equipment.
D. Closely follow the manufacturer’s instruction in laying and joining pipe.
E. Cut pipe for inserting valves, fittings, etc., in a neat and workmanlike manner without damaging the pipe so as to leave a smooth end at right angles to the axis of the pipe.
F. Locate waterlines in relation to other piped utilities in accordance with Section 33 11 13.
G. Concrete encase waterlines as shown on the Plans, or as directed by the Engineer.

3.03 INSTALLING APPURTENANCES

A. Securely plug open ends of pipe at the close of each work day and during temporary discontinuance of pipe laying.
B. Set all valves, fittings, hydrants, and other specials in a neat workman like manner.
C. Use thrust blocks, as shown on the Plans, pipe anchors, or other approved means to prevent displacement or other fittings.
D. Erect hydrants to stand plumb with the pumper nozzle facing the road.
E. Effect drainage of hydrants by using six cubic feet of gravel.
F. Close dead ends with cast iron plugs or caps and equip with blow-off assemblies, where shown on the Drawings.

3.04 HIGHWAY AND RAILROAD CROSSINGS

A. Perform highway crossings by the open cut method, unless otherwise shown on the Drawings or required by the appropriate authorities.
B. Boring and jacking of crossings, if necessary, will be performed and paid for in accordance with Section 33 05 23.

3.05 WATER LINE PRESSURE TESTS

A. Contractor shall provide all necessary testing equipment to complete required testing. Contractor shall perform all testing which will be observed by the Owners field representative.
B. After the pipe has been laid, subject all newly laid pipe or any valved section thereof to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing.
C. Test pressures shall:
   1. Be not less than 1.25 times the working pressure at the highest point along the test section.
   2. Not exceed the pipe and thrust restraint design pressures.
   3. Be of at least two-hour duration.
   4. Not vary by more than ±5 psi.
   5. Not exceed twice the rated pressure of closed valves or hydrants included in the test section.
   6. Not exceed the rated pressure of resilient-seated butterfly valves.
D. Pressurization:
   1. Slowly fill each valved section of pipe with water.
   2. Apply the specified test pressure based on the elevation of the lowest point of the line or section under test, and correct to the elevation of the test gauge by means of a pump connected to the pipe in a manner satisfactory to the Owner.
E. Air Removal:
   1. Before applying the specified test pressure, expel air completely from the pipe, valves,
and hydrants.
2. If permanent air vents are not located at all high points, install corporation cocks at such points to expel air as the line is filled with water.
3. After all the air has been expelled, close the corporation cocks and apply the test pressure.
4. At the conclusion of the pressure test, remove the corporation cocks and plug or leave in place at the discretion of the Owner.

F. Examination:
1. Carefully examine all exposed pipe, fittings, valves, hydrants, and joints.
2. Repair or replace any damaged or defective pipe, fittings, valve, or hydrants, that are discovered with sound material and repeat the test until it is satisfactory to the Owner.

3.06 WATER LINE LEAKAGE TESTS

A. Conduct a leakage test concurrently with the pressure test.
B. Leakage defined: the quantity of water that must be supplied into the newly laid pipe to maintain the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.
C. Allowable leakage:
1. Determine allowable leakage by:

$$ L = \frac{ND}{P} $$

Where $L$ is the allowable leakage, in gallons per hour; $N$ is the number of joints in the tested pipeline; $D$ is the nominal diameter of the pipe, in inches; and $P$ is the average test pressure during the leakage test in psig.
2. Table of allowable leakage at various pressures is shown in the following table:

<table>
<thead>
<tr>
<th>Test Pressure PSI</th>
<th>NOMINAL PIPE DIAMETER - INCHES</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>450</td>
<td>0.3</td>
</tr>
<tr>
<td>400</td>
<td>0.3</td>
</tr>
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<tr>
<td>125</td>
<td>0.2</td>
</tr>
<tr>
<td>100</td>
<td>0.2</td>
</tr>
</tbody>
</table>

*For Mechanical or push-on joint pipe with 18' nominal lengths. To obtain the recommended allowable leakage for pipe with 20' nominal lengths, multiply the leakage calculated from the above table by 0.9. If the pipeline under test...
contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

3. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.078 gal/hr/in. of nominal valve size shall be allowed.
4. When hydrants are in the test section, test against the closed hydrant.

3.07 ACCEPTANCE OF INSTALLATION

A. If any test of pipe laid discloses leakage greater than that specified above, locate and repair the defective material until the leakage is within the specified allowance.
B. Repair all visible leaks regardless of the amount of leakage.

3.08 CLEANING AND DISINFECTION OF WATER LINES

A. Waterlines shall be cleaned and disinfected according to AWWA C651.
B. Flush waterlines clean prior to disinfection.
C. The main shall be filled with water at the rate to ensure the water within the main will flow at a velocity no greater than 1 ft/second.
D. Thoroughly disinfect waterlines prior to placing in service.
   1. Use chlorine disinfecting agent applied to produce a 50 ppm dosage.
   2. Allow water to escape from the ends of all lines to cause dispersion of the chlorine solution into all parts of the system.
   3. Operate all valves and hydrants during the time disinfection is occurring.
   4. Retain the chlorine solution in the lines for a period of 48 hours.
   5. At the end of the 48-hour period, the residual chlorine must be a minimum of 25 ppm. Otherwise, repeat the disinfection procedure again.
   6. Upon refilling the lines, collect a sample for bacteriological analysis every 1,200 feet of the new main. If the sample is acceptable, the lines may be connected to the system. Otherwise repeat the disinfection procedure until acceptable samples are obtained.

END OF SECTION 33 10 00
SECTION 33 11 13 - SEPARATION OF PIPED UTILITIES

PART 1—GENERAL

1.01 REQUIREMENTS INCLUDED
   A. Location of piped utilities to separate water mains from sewer facilities.

1.02 RELATED WORK
   A. Appropriate Piped Utility Sections (33 Numbers).

PART 2—PRODUCTS
   (Not Used)

PART 3—EXECUTION

3.01 PARALLEL INSTALLATION
   A. Separate water mains at least 10 feet horizontally, measured edge to edge, from any sewer facility whenever possible.
   B. When local conditions prevent a horizontal separation of 10 feet, closer installations may be made if:
      1. The bottom of the water main is at least 18" above the top of the sewer facility; or
      2. The sewer is constructed of materials equivalent to water main standards and pressure tested and/or vacuum tested to assure watertightness prior to backfilling.

3.02 CROSSINGS
   A. Separate water mains crossing sewer facilities by at least 18" between the bottom of the water main and the top of the sewer facility whenever possible.
   B. When local conditions prevent a vertical separation as described above, the following construction shall be used:
      1. Sewers passing over or under water mains should be constructed of materials equivalent to water main standards and pressure and/or vacuum tested to assure watertightness prior to backfilling.
      2. Water mains passing under sewers shall, in addition, be protected by providing:
         a. A vertical separation of at least 18" between the bottom of the sewer and the top of the water main.
         b. Adequate structural support for the sewer to prevent excessive deflection of joints and settling on and breaking the water mains.
         c. That the length of water pipe be constructed with mechanical-joint pipe for a distance of 10 feet on each side of the sewer and centered at the point of crossing so that the joints will be equidistant and as far as possible from the sewer.
3.03 SEWER FACILITIES

Do not install water mains or sewer facilities that pass through or contact each other.

END OF SECTION 33 11 13
SECTION 33 30 00 - SANITARY SEWERAGE SYSTEMS

PART 1—GENERAL

1.01 WORK INCLUDED
A. Installation of sanitary sewerage systems.

1.02 RELATED WORK
A. Section 31 23 00: Excavation and Fill.
B. Section 33 05 23: Trenchless Utility Installation.
C. Section 33 11 13: Separation of Piped Utilities.
D. Section 03 00 00: Concrete.

PART 2—PRODUCTS

2.01 POLYVINYL CHLORIDE PIPE AND FITTINGS
A. Manufactured from virgin, National Sanitation Foundation (NSF) approved resin conforming to ASTM D-1784.
B. Unless otherwise specified, all PVC pipe and fittings shall conform to ASTM D-3034 and have a standard dimension ratio (SDR) of 35, or conform to ASTM F-679.
C. The gaskets used for joining PVC sewer pipe shall conform to ASTM F-477.
D. All PVC gravity sewer pipe shall be clearly marked with the manufacturer’s name, nominal diameter, SDR, ASTM D-3034, and NSF-approved seal.
E. All force main sewer shall be Polyvinyl Chloride (PVC) plastic pipe. PVC pipe shall be made from Type 1, Grade 1 PVC, and shall meet the requirements of ASTM D2241 or AWWA C900, or SDR-21, and ASTM D3139 for PVC joints. Rubber gaskets for PVC pipe shall be molded as an integral part of the bell.
F. Tracer wire shall be installed in trench prior to backfilling for all non-metallic pipes.

2.02 DUCTILE IRON PIPE AND FITTINGS
A. Pipe:
1. Manufactured in accordance with ANSI A-21.50 (AWWA C-151) and ANSI A-21.10 (AWWA C-110).
2. Pipe and fittings shall be lined with Protecto 401 Ceramic Epoxy, or approved equal lining meeting the following material specifications:
   a. The material used for lining the pipe and fittings must have a successful history of protecting sewer pipelines. The material must be a high build multi-component Amine cured Novalac Epoxy lining. The standard of quality is Protecto 401 Ceramic Epoxy. Any request for substitution must meet the following criteria and be accompanied by:
      i. The permeability rating when tested according to Method A of ASTM E-96-66, Procedure A with a test duration of 42 days as reported by an independent laboratory.
      ii. A statement from the manufacturer of the submitted material attesting to the fact that at least 20% of the volume of the lining contains ceramic quartz pigment.

iv. A statement concerning recoatability and repair to the lining.

3. Shall have a minimum of 1 mil thick bituminous coating on the outside surface.

4. Shall be clearly marked with manufacturer’s name, DI or ductile, weight, class or nominal thickness, and casting period.

5. Unless otherwise specified or shown on the Plans, ductile iron pipe shall be Pressure Class 350 for diameters 3” through 12”, Pressure Class 250 for diameters 14” through 24”, and Pressure Class 150 for diameters 30” through 64”.

B. Fittings:
1. Fittings 2” - 24”: Pressure rated at 350 psi.
2. Fittings 30” - 36”: Pressure rated at 250 psi.
3. Joints meeting the requirements of ANSI A-21.11 (AWWA C-111), mechanical joints or push on joints.

2.03 CENTRIFUGALLY CAST FIBERGLASS REINFORCED POLYMER MORTAR (CCFRPM) PIPE

A. Materials
1. Resin Systems: The manufacturer shall use only polyester resin systems with a proven history of performance in this particular application. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product.

2. Glass Reinforcements: The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade E-glass filaments with binder and sizing compatible with impregnating resins.

3. Silica Sand: Sand shall be minimum 98% silica with a maximum moisture content of 0.2%.

4. Additives: Resin additives, such as curing agents, pigments, dyes fillers, thixotropic agents, etc., when used, shall not detrimentally affect the performance of the product.

5. Elastomeric Gaskets: Gaskets shall be supplied by approved gasket manufacturers and be suitable for the service intended.

B. Manufacture and Construction
1. Pipes: Manufacture pipe by the centrifugal casting process to result in a dense, non-porous, corrosion-resistant, consistent composite structure.

2. Joints: Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets made of EPDM rubber compound as the sole means to maintain joint watertightness. The joints must meet the performance requirements of ASTM D4161. Joints at tie-ins, when needed may utilize fiberglass, gasket-sealed closure couplings.

3. Fittings: Flanges, elbows, reducers, tees, wyes, laterals and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass-fiber-reinforced overlays. Properly protected standard ductile iron, fusion-bonded epoxy coated steel and stainless steel fittings may also be used.

4. Acceptable Manufacturer: Hobas Pipe USA, Inc.

C. Dimensions
1. **Diameters:** The actual outside diameter (18" to 48") of the pipes shall be in accordance with ASTM D3262. For other diameters, OD's shall be per manufacturers literature.

2. **Lengths:** Pipe shall be supplied in nominal lengths of 20 feet. Actual laying length shall be nominal ± 1, -4 inches. At least 90% of the total footage of each size and class of pipe, excluding special order lengths, shall be furnished in nominal length sections.

3. **Wall Thickness:** The minimum wall thickness shall be the stated design thickness.

4. **End Squareness:** Pipe ends shall be square to the pipe axis with a maximum tolerance of 1/8".

**D. Testing**

1. **Pipes:** Pipes shall be manufactured and tested in accordance with ASTM D3262.

2. **Joints:** Coupling Joints shall meet the requirements of ASTM D4161.

3. **Stiffness:** Minimum pipe stiffness when tested in accordance with ASTM D2412 shall normally be 46 psi.

**E. Customer Inspection**

1. The Owner or other designated representative shall be entitled to inspect pipes or witness the pipe manufacturing.

2. **Manufacturers Notification to Customer:** Should the Owner request to see specific pipes during any phase of the manufacturing process, the manufacture must provide the Owner with adequate advance notice of when and where the production of those pipes will take place.

**F Packaging, Handling, Shipping**

1. Packaging, handling, and shipping shall be done in accordance with the manufacturer's instructions.

**2.04 CONCRETE MATERIALS**

Structural concrete in accordance with Section 03 0000.

**2.05 CASTINGS FOR FRAME AND COVERS**

**A. Standard Manhole Frames and Covers**

1. The manhole frame and cover shall be Ductile Iron and shall conform to ASTM A536 and be traffic load rated in accordance with AASHTO H20 requirements and meet Federal Specification RRF-621-E or current Standard. The cover shall be capable of sustaining a load test of 50 tons without failure.

2. Cleaned and coated with bituminous paint that will produce an acceptable finish that is not affected by exposure to hot or cold weather.

3. Rings and covers for use on watertight manholes shall be machined to a smooth uniform bearing that will provide a watertight seal.

4. All covers shall bear the words “Sanitary Sewer”.

5. The frame shall have a clear opening of 24" and be 4" in height. The cover shall sit on a 360° Elastomer seat ring and hinge open to a position of 130°. During the closing cycle, the cover must mechanical pause/lock at the 90° position. The hinge shall not be load bearing when in the closed position. The cover shall have a safety label cast into it as a warning to prohibit entry into the manhole without first removing the cover from the frame. The cover shall be capable to being lifted out of the frame at the 90° position. The cover shall provide for an optional locking mechanism. Cover shall weigh 73 lbs ± 5%.

6. Frame and cover manufacturer shall have been in production of ductile iron frames and covers for a minimum of 10 years and be ISO 9001 certified.

7. Standard manhole frames and covers shall be equal to Pamrex.
B. Watertight Manhole Frames and Covers

8. The manhole frame and cover shall be Ductile Iron and shall conform to ASTM A536 and be traffic load rated in accordance with AASHTO H20 requirements and meet Federal Specification RRF-621-E or current Standard. The cover shall be capable of sustaining a load test of 50 tons without failure.

9. The frame shall have a clear opening of 24” and be 4” in height. The frame shall have six ductile iron cams for locking the cover. The cans shall be locked into place by stainless steel bolts. Bolt holes shall be blind to protect the bolts from internal gases. Bolt and cam design shall be such that it is not necessary to remove either from the frame in order to lift the cover out.

10. The cover shall sit on a 360° Elastomer seat ring for watertightness and a separate polyethylene ring for load transmission. There shall be a closed handling box cast into the cover. Cover shall weigh 116 lbs ± 5%.

11. Frame and cover manufacturer shall have been in production of ductile iron frames and covers for a minimum of 10 years and be ISO 9001 certified.

12. Watertight manhole frames and covers shall be equal to Pamtight.

2.06 PRECAST CONCRETE MANHOLES

A. Unless otherwise specified, all sanitary sewer manholes shall be precast concrete type.
B. AASHTO M-199 SR or ASTM C-478.
C. Openings shall be provided for the required number and size pipes and shall be marked to insure installation at proper locations.
D. Use o-ring joints, “Mastic” joint in accordance with ASTM C-443 or ASTM C-361, or joints as specified by the manhole manufacturer at all joints between sections in sanitary sewer manholes.
E. Use Type II cement for increased sulfate resistance.
F. Provide manholes with lift holes that do not completely penetrate the wall of manhole sections.
G. Manhole bases for depths greater than 15’ are to be double reinforced wire mesh with a minimum height of 1’ of concrete above the pipe opening.
H. All precast manhole manufacturers shall be NPCA certified/approved.
I. Manholes shall be of watertight construction. Unless noted on plans, in streets, manhole tops shall be set by the road grade. A maximum of 12 inches of adjustment rings may be used to reach grade. In easements a minimum of 12 inches, maximum of 24 inches of manhole shall be above grade unless noted otherwise on plans. No adjustment rings shall be used to reach this elevation. All precast manhole lift rings shall be removed and all lift holes sealed. Inverts shall be installed in a workmanlike manner, providing a smooth flow line without obstructions in accordance with the standard details.

2.07 MANHOLE STEPS

A. ASTM C-478.
B. Cast iron steps: ASTM A-48, Class 30.
C. Aluminum steps: fabricated from aluminum alloy 6061, T6.
D. Polypropylene plastic molded around a steel rod.
E. Manhole steps shall be corrosion resistant, free from sharp edges, burrs, or other projections that may be a safety hazard and shall be of sufficient strength to be a live load of 300 pounds imposed at any point.
F. General dimensions shall be 12 inch wide (min) uniformly spaced from 12 inches minimum to 16 inches maximum. Step shall be of the cast in place type, manufactured and installed in accordance with the latest OSHA regulations.
G. The legs and struts shall be of sufficient length for the cleat to project a minimum clear distance of 4" from the wall when the step is securely imbedded in the manhole wall.
H. The top surface of the cleats shall be designed to prevent foot slippage.

2.08 PIPE ENTRANCE COUPLINGS FOR MANHOLES

Connections between pipes and manholes shall be watertight, made with flexible gaskets and meeting quality standards of ASTM C-443. Internal aluminum band material shall conform to specification 6061-T6, T651. External band shall be 304 Stainless Steel conforming to ASTM Specification A-167. Use Kor-N-Seal Boot, PSX Boot, or equivalent. Provide connection for all pipes including service connections and vents.

2.09 ECCENTRIC PLUG VALVES:

A. All eccentric plug valves shall be of the welded-in nickel seat type, cast iron body, and suitable for operating pressures of at least 175 psi (4"-12") or 150 psi (over 12"). Valves shall be of standard manufacturer and of the highest quality both as to materials and workmanship.
B. All eccentric plug valves shall be furnished with mechanical joint end connections, unless otherwise shown on the drawings or specified hereinafter.
C. An epoxy coating shall be applied to the interior and exterior ferrous surfaces of the eccentric plug valve except for finished or seating surfaces.
D. All eccentric plug valves shall have the name or monogram of the manufacturer, the year the valve casting was made, the size of the valve, and the operating pressure cast on the body of the valve.
E. Each buried eccentric plug valve shall be installed in a vertical position with a roadway type valve box. Eccentric plug valves set with valve boxes shall be provided with a 2-inch square operating nut and shall be opened by turning to the left (counter clockwise). There shall be a maximum 48" depth of valve operating nut. The Contractor must use extension stems, if necessary, to raise operator nut within 48" of final grade. Extensions must be securely attached to the operating nut so the shaft will not pull off of the operator.
F. Each 6" or smaller eccentric plug valve in a pit or open installation shall have a lever actuator. Eccentric plug valves larger than 6" shall have a handwheel actuator.

PART 3—E: EXECUTION

3.01 PREPARATION

A. Prior to laying pipe, prepare a suitable bedding according to Section 31 23 00.
B. Before placing pipe in the trench, field inspect for cracks or other defects; remove defective pipe from the construction site.
C. Swab the interior of the pipe to remove all undesirable material.
D. Prepare the bell end and remove undesirable material from the gasket and gasket recess.

3.02 INSTALLING GRAVITY SANITARY SEWERS

A. Lay pipe true to the lines and grades from the grade and alignment stakes, or equally usable references.
   1. Where laser equipment is used, provide offset hubs at every manhole location for purposes of checking grade between sections.
   2. Where batter boards are used, furnish stakes at intervals of 50 feet along the route of the pipeline for lines smaller than 18 inches. For lines 18 inches and larger, use 25 foot
3. Set stakes at such distance from centerline of excavations as is suitable for the method and machinery used.
4. Provide and use accurately set batter boards at each 50 and 25 foot intervals in establishing the bottom invert of each pipe laid.

B. Accurately establish the centerline of each pipe using a string stretched between targets and a plumb line extended to the centerline of the pipe.

C. Carefully inspect all pipe and each fitting prior to its placement in the trench, and reject and remove any defective pipe or fitting from the job site.

D. Lay pipe progressively upgrade, with bell upstream, in such a manner as to form close, concentric joints with smooth bottom inverts. Joining of all pipe shall be in accordance with manufacturer’s specifications.

E. Bed each pipe section in accordance with Section 31 23 00.

F. Unless otherwise specified, provide all gravity sewer lines with a minimum of 4 feet of cover in roadways and 2-1/2 feet of cover in open areas, unless ductile iron pipe or concrete encasement is used. Any lines crossing a State Highway shall have a minimum depth of cover of 4 feet. All depths of cover are measured to the top of the pipe.

G. Do not allow walking on completed pipelines until backfill has been placed to a depth of at least 6 inches above the crown of the pipe.

H. Keep the interior of the pipe free of all unneeded material, and upon completion of a section between any two manholes it shall be possible to view a complete circle of light when looking through the pipe.

I. When pipe laying ceases, close the open ends of the pipe with a plug suitable for preventing the entrance of foreign materials.

J. Couplings and adapters used for joining dissimilar gravity pipe materials, for repairing and rejoining sections of gravity sewer, shall meet the requirements of ASTM C-594.

K. All couplings and adapters for gravity sewer pipe shall be of rubber, plastic, and metallic materials that will not be attacked by municipal wastewaters or aggressive elements in the soil and conform to ASTM C-425, Section 5.

L. Pipe material for gravity sewer lines fifteen inches and smaller shall be PVC, unless otherwise specified.

M. Connect new lines to existing manholes as shown on the Drawings and include flow channel reconstruction; all repairs to the existing structure shall be watertight and to the satisfaction of the Engineer.

N. Sewage flow must be maintained in the existing sewer interceptor. Whenever pipe-laying progresses to a point where this flow must be interrupted the Contractor shall plug the sewer upstream of the construction and provide pump bypassing to a downstream manhole. All downstream pipes, manholes and appurtenances must be tested and acceptable to the Owner and the Engineer prior to receiving sewage flow. When working in areas where interruption of sewer flow may occur, the Contractor shall have at the site pumps, lines and all other equipment in readiness to provide pump bypassing.

O. The Contractor shall plan work and arrange work schedules to minimize the length of time sewer service is interrupted. At no time shall sewage be discharged on the ground or to any watercourse.

P. New connections to existing customers and tie-in of lateral sewers shall be accomplished as determined necessary and at the times requested by the Engineer and Owner. Connections, excavation to determine existing sewer locations, plugs both temporary and permanent, existing line abandonment and permanent sealing shall be considered incidental items necessary for construction.

Q. Check dams shall be installed in the bedding and backfill of all new or replaced sewer lines to limit the drainage area subject to french drain effect of gravel bedding. Major rehabilitation projects
should also include check dams in the design. Dams shall consist of compacted clay bedding and backfill at least three feet thick to the top of the trench and cut into the walls of the trench two feet. Alternatively, concrete may be used, keyed into the trench walls. Dams shall be placed no more than 500 feet apart. The required location is upstream of each manhole. All stream crossings shall include check dams on both sides of the crossing.

R. Location Tape: Plastic encased aluminum foil tape shall be installed above all non-metallic pipe such that pipe can be located in the future with a metal locating device. Tape shall be color coded and permanently imprinted with identification message. Tape shall be LINEGUARD Detectable Underground Marking Tape, or equal.

S. Pipe Deflection: When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane, the amount of deflection shall not exceed 2/3 of the deflection limits recommended by the manufacturer. The trench may be curved to change direction or to avoid obstructions within the limits of the curvature of the pipe as recommended by the pipe manufacturer. Required curvature shall be maintained using full joints and/or fittings. Short sections of pipe shall not be used without approval of Engineer.

T. Installing Centrifugally Cast Fiberglass Reinforced Polymer Mortar (C CFRPM) Gravity Sanitary Sewers:
1. Burial: The bedding and burial of pipe and fittings shall be in accordance with the project Plans and specifications and the manufacturer's requirements.
2. Pipe Handling: Use textile slings, other suitable materials or a forklift. Use of chains or cables is not recommended.
3. Jointing:
   a. Clean ends of pipe and coupling components.
   b. Apply joint lubricant to pipe ends and elastomeric seals of coupling. Use only lubricants approved by the pipe manufacturer.
   c. Use suitable equipment and end protection to push or pull the pipes together.
   d. Do not exceed forces recommended by the manufacturer for coupling pipe.
   e. Join pipes in straight alignment then deflect to required angle. Do not allow the deflection angle to exceed the deflection permitted by the manufacturer.

3.03 INSTALLING SANITARY SEWERS PUMP STATION
A. Not Applicable.

3.04 INITIAL PROOF TESTING OF SANITARY SEWERS
A. It is the intent to specify a “test as you go” procedure in order to establish confidence in the installation and avoid the unnecessary delay of final acceptance.
B. Before a reach of pipeline is approved for payment, successfully proof test that reach for grade, alignment, and cleanliness.
C. In the event that four or more reaches fail to satisfactorily pass proof testing procedures, cease laying pipe until deficiencies are identified and corrected.
D. The basis for grade, alignment, and cleanliness testing will be visual inspection. Leakage testing will be by means of low pressure air as specified hereinafter.
E. Proof test flexible pipeline installation for deflection by pulling a “go-no go” test mandrell through the line after the initial backfill is complete to avoid unnecessary digups.

3.05 FINAL TESTING
A. A final testing procedure is to be followed before the job is accepted.
B. All sewers and manholes shall be built practically watertight and the Contractor shall adhere rigidly to materials and workmanship. After completion of certain line segments, the Contractor shall immediately air test sections thereof. If leakage is above limits specified, the sewer shall be replaced. The Owner may request infiltration/exfiltration tests after project completion on selected line segments, but all line shall be first air tested.

C. Prior to acceptance of completed sewer lines, the lines shall be inspected and tested to ensure compliance with the following provisions. After the sewer lines have been brought to completion and prior to final inspection, the Contractor shall clean out the downstream segments. Each individual line will be cleaned by pushing appropriate tools from manhole to manhole to remove any and all debris and obstructions or may, if possible, flush clean with water or remove by hand. Water may be turned into the system to determine whether the competed lines are true to line and grade as laid out or as shown on the Drawings. All lines or sections of lines that are laid with improper line or grade, that contain broken sections of pipe, that are obstructed in such a manner that they cannot be satisfactorily corrected otherwise, or are deflected in excess of the allowable, shall be removed and replaced.

B. Perform a visual inspection when ground water levels are above the pipeline if possible. All visible leaks shall be repaired.

C. If there is evidence of infiltration, make measurement with suitable flow data recorders.
   1. If the flow through the lowermost manhole of a continuous section of sewer does not exceed 50 gallons day/inch/mile of pipeline and the groundwater level is representative of the highest annual level, the entire continuous section shall be approved for leakage.
   2. The leakage test will be conducted with all lines connected (including service lines).
   3. If the apparent infiltration rate exceeds 50 gallon/day/inch/mile, then take additional weir measurements to isolate those sections leaking.
   4. Any single reach of pipeline that exhibits an apparent infiltration rate in excess 50 gallon/day/inch/mile will not be accepted and all leaks will be located and corrected.

D. If it is not practical to wait for groundwater levels that are representative of the highest annual level, the Contractor may request approval on the basis of a low pressure air exfiltration test.
   1. Such test, if approved by the Engineer, will be conducted in accordance with ASTM C-828.
   2. When an exfiltration test is used as a substitute for infiltration testing, correct all conditions that are potential sources of infiltration.

E. If flexible pipe is used, pull an approved go-no go deflection mandrel of 95/100 pipe diameter through all reaches of gravity sewer main. No sections will be accepted that exhibit a deflection of more than five percent.
   1. The CONTRACTOR is responsible for providing all labor and equipment for deflection testing.
   2. Test deflection of the pipe by manually pulling with twine a one-piece nine-arm go/no-go mandrel (sized in accordance with ASTM D3034) through the pipe. Within 24 hours after compaction of the backfill is complete, the line shall be tested using a 5% deflection mandrel (3% for Hobas Pipe). If the line is satisfactory, it shall be retested using a 7.5% deflection mandrel (4% for Hobas Pipe) no less than 30 days following the completion of compaction.

3.06 LOW PRESSURE AIR EXFILTRATION TEST FOR SEWERS 24 INCHES IN DIAMETER AND SMALLER

A. The section of sewer to be tested shall have been backfilled.
B. Both ends of the pipe section being tested shall be sealed airtight.
C. Pressurize the sealed pipe to 4 psig above the average back pressure of ground water over the sewer pipe at the time of the test and allow the air pressure to stabilize for at least two minutes.
D. After the stabilization period, adjust the pressure to 3.5 psig and measure the time in minutes and seconds for the pressure to drop by either 1 psig or 0.5 psig. If ground water is present, the starting air pressure shall be increased to 3.5 psig above the level of the ground water and the time measured.

E. The time measured for the pressure drop to occur shall be according to ASTM F1417-92, and shall not be less than that shown in the following tables:

**Minimum Specified Time Required for a 1.0 psig Pressure Drop for Size**

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>100'</th>
<th>150'</th>
<th>200'</th>
<th>250'</th>
<th>300'</th>
<th>350'</th>
<th>400'</th>
<th>450'</th>
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<td>19:13</td>
<td>25:38</td>
<td>32:03</td>
<td>38:27</td>
<td>44:52</td>
<td>51:16</td>
<td>57:41</td>
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<tr>
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<td>26:10</td>
<td>34:54</td>
<td>43:37</td>
<td>52:21</td>
<td>61:00</td>
<td>69:48</td>
<td>78:31</td>
</tr>
</tbody>
</table>

**Note 1** – See Practice UNI-B-6-98.

**Note 2** - If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be accepted and the test complete.

**Minimum Specified Time Required for a 0.5 psig Pressure Drop for Size**

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>100'</th>
<th>150'</th>
<th>200'</th>
<th>250'</th>
<th>300'</th>
<th>350'</th>
<th>400'</th>
<th>450'</th>
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<td>11:08</td>
<td>13:21</td>
<td>15:35</td>
<td>17:48</td>
<td>20:02</td>
</tr>
</tbody>
</table>

**Note 1** – See Practice UNI-B-6-98.

**Note 2** - If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be accepted and the test complete.

F. All pipes shall be lamped and shall show a full circle.

G. Repair or replace any line that fails any of the above tests and retest.

H. If flexible pipe is used, pull an approved go-no-go deflection mandrel of 95/100 pipe diameter through all reaches of gravity sewer main. No sections will be accepted that exhibits a deflection of...
more than 5 percent.

I. Sewer service assemblies shall be installed and capped at locations directed by the Engineer, and shall be included in Final Testing.

J. All tests shall be witnessed by the Engineer.

3.07 TESTING FOR SEWERS LARGER THAN 24 INCHES IN DIAMETER

A. The Contractor is responsible for providing all labor and equipment for testing. Testing may be accomplished via either ultrasonic test or seepage and infiltration test.

B. Ultrasonic Test
   1. The Contractor shall utilize an ultrasonic method to detect leaks. An ultrasonic transmitter shall be utilized to determine if a leak has occurred, which will be indicated by the sound of a running faucet.
   2. If the pipe is buried, then the ultrasonic test shall be carried out by placing a metal rod on the pipe and placing the transmitter on the metal rod to listen for leaks. Proceed in 10 to 25 foot intervals.

C. Seepage and Infiltration Test
   1. Where the natural groundwater is 24 inches or more above the top of a section of pipe, the Contractor shall measure the flow of water in the pipe and the rates of seepage and infiltration. Measure the flow rate by using a calibrated weir. Leave the weir in the line until the flow rate has stabilized. The Contractor is responsible for verifying the groundwater level by providing sight gauges in manholes or digging test holes at suitable locations.
      a. The total seepage and infiltration of groundwater as determined by the test shall in no case exceed 50 gallons per 24 hours per inch-mile of pipe. Make infiltration tests on all sewer construction before placing the lines in service and before making any connections to other sewers. If the amount of infiltration into the sewer(s) is in excess of the maximum quantity specified above, then repair the joints, relay the sewer (if necessary), or perform other remedial construction, at the Contractor’s expense, in order to reduce groundwater infiltration to within the specified limits.
      b. In making infiltration tests, furnish the required equipment and labor and do the necessary pumping under the direction on the Owner. Tests may be repeated until each sewer individually meets the Specifications for infiltration amounts as set above.
   2. Where the groundwater is not 24 inches or more above the top of the pipe section being tested, the Contractor shall perform an exfiltration test. Bulkhead the pipe below the lower manhole of the section being tested with a pneumatic plug or other device. Insert a vent pipe 48 inches long in the stopper of the upper end of that section. Then fill the lower manhole with water, or add water until there is a minimum of 4 feet over the upper end; make certain that all air is forced out through the vent tube. Measure the drop in the level of the water in the manhole due to exfiltration over a specific time, and calculate the water loss due to exfiltration. The total exfiltration shall not exceed that specified above for infiltration.

3.08 SEWER MANHOLES—GENERAL

A. Unless otherwise specified, all manholes shall have an inside diameter of not less than 4 feet and a vertical wall height of not less than 2.5 feet.

B. The clear opening in the manhole shall not be less than 2 feet.
C. Depth of the manhole shall be the vertical distance from the lowest invert in the manhole to the top of the frame and cover assembly.
D. Apply an application of bituminous material to the outside of each manhole section prior to backfilling and preferably when making the vacuum test.
E. Backfill manholes with the same material used for pipelines, or, in traffic areas, with sized rock or flowable fill, to reduce compaction issues.
F. Mechanically tamp Class I material a distance of at least one full pipe length to prevent settlement of pipelines.
G. Frame and cover shall not be installed in curb-lines.

3.09 STANDARD PRE-CAST CONCRETE MANHOLES
A. Unless otherwise specified on the Plans, all manholes shall be pre-cast.
B. ASTM C-478, with o-ring joints or “Mastic” joints in accordance with ASTM C-433 or ASTM C-361, or as specified by the manhole manufacturer. Use Type II cement.
C. The base of the manhole shall be Class C concrete not less than 8” in depth with inverts not less than 4” in depth.
D. Shape manhole inverts from Class B concrete to be smooth, accurately shaped, and in accordance with the Plans. Inverts shall be of such shape and slope to provide smooth transition between inlet and outlet sewers and to minimize turbulence. Channeling height shall be to the crowns of the sewers. Benches shall be sloped form the manhole wall toward the channel to prevent accumulation of solids.
E. Inlets and outlets from each manhole shall drop 0.10 foot across the manhole, unless otherwise shown on the Plans, and shall be finished smooth and flush with the sides of the manhole walls so as not to obstruct the flow of liquid through the manhole.
F. When possible, the base of the manhole shall sit on dry, consolidated and undisturbed soil.
G. When wet or unconsolidated material occurs or when over-excavation of the base occurs, provide a subbase with minimum of 12” of Class I, granular material, well compacted with mechanical tamping equipment.
H. When completed, the manhole shall be free from channel obstructions and leakage.
I. Use of concrete grade rings will be limited to a vertical height of less than sixteen inches, with joints between each ring sealed with preformed gasket material.
J. All section joints shall be grouted inside and outside.
K. All manholes shall be vacuum tested prior to backfilling operations.

3.10 CAST-IN-PLACE CONCRETE MANHOLES
A. Unless specifically called for on the Plans or as directed by the Owner, cast-in-place concrete manholes will not be allowed.
B. Manholes shall conform to the dimensions outlined on the Plans.
C. The vertical forms, wall spacers, steps, and placing cone must be carefully positioned and firmly clamped in place before any placement is made.
D. The wall spacers must be located 90 degrees from each other.
E. Use structural concrete with a maximum slump per Section 03 00 00.
F. First place approximately 1/2 yard of concrete evenly around the walls and vibrate until there is a minimum slope of 60 degrees from the bottom of the forms to the bearing surface both inside and outside of the manhole.
G. When this is complete and before additional concrete is added, vibrate the concrete on each side of each pipe.
H. Deposit additional concrete in evenly distributed layers of about 18” with each layer vibrated to
bond it to the preceding layer.

I. Raise the wall spacers as the placements are made, with the area from which the spacer is withdrawn being carefully vibrated.

J. Excessive vibration is to be avoided.

K. A maximum of two percent calcium chloride may be added to the concrete, at the Contractor’s option, to speed the set.

L. Remove the forms as soon as the concrete has sufficiently set, but not within six hours of pouring and not without approval.

M. Excessive honeycombs will be cause for rejection of the manhole. Honeycombs and other imperfections shall be mortared as soon as possible after form removal so that a proper bond will take place.

N. Form marks and offsets of up to 2” will be permitted on the outside surface of the manhole.

O. Form marks and offsets up to 3” will be permitted inside of the manhole.

P. All offsets on the inside surface of the manhole will be smoothed and plastered so that there is no projection or irregularity capable of scratching a worker or catching and holding water or solid materials.

Q. Honeycomb will be plastered with mortar consisting of three parts masonry sand to one part Portland cement immediately upon removal of the forms.

R. Concrete shall contain xypex or equivalent admixture to ensure <1 percent permeability.

3.11 MANHOLE STEPS

A. Set manhole steps at intervals of 16” along the wall of the manhole.

B. The treads of the steps shall be free from mortar or other material when the manhole is completed.

C. In precast manholes, the holes left to receive the steps shall be mortared smooth following placement of the steps.

D. Steps shall be installed in a straight line.

E. Steps shall be oriented in plan view to accommodate proper positioning of frame and cover.

3.12 MANHOLE RINGS AND COVERS

A. Joint shall be sealed with Kent Seal Butyl Rubber sealant as manufactured by Hamilton Kent. Grout manhole rings and covers in place with cement mortar.

B. The bearing surfaces between cast rings and covers shall be machined, fitted together, and match marked to prevent rocking.

C. All castings shall be of the types, dimensions, and weights as shown on the Plans and shall be free of faults, cracks, blow-holes, or other defects.

3.13 DROP MANHOLE ASSEMBLIES

A. Drop manhole assemblies shall be constructed as outlined on the Plans.

B. The material used in the drop pipe construction shall be ductile iron and Class “B” concrete, as specified by the Engineer.

3.14 MANHOLE VACUUM TEST

A. All manholes, including frames, shall be subjected to and shall pass a vacuum test of at least 10” Hg, prior to acceptance. The Contractor shall be responsible for providing the equipment required for the testing, including the manhole sealing apparatus, gauges, pump, plugs, and operating personnel. The equipment shall be top quality, in good condition and approved by the Engineer for
B. Each manhole shall be tested immediately after assembly and prior to backfilling. The lifting holes shall be plugged with an approved nonshrink grout. The pipes entering the manhole shall be plugged, taking care to securely brace the plugs to prevent them from being drawn into the manhole. The rim to cone joint shall be tested on all manholes with watertight covers. No one shall be inside the manhole during testing.

C. Installation and operation of vacuum equipment and indicating devices shall be in accordance with equipment specification for which performance information has been provided by the manufacturer and approved by the Engineer.

D. With the vacuum tester set in place on top of the cone section of the manhole
   1. Inflate the compression band seal in accordance with the manufacturer's recommendations.
   2. Connect the vacuum pump to the outlet port with the valve open and draw a vacuum of 10" of mercury (Hg).
   3. Close the valve and shut off vacuum pump.
   4. Measure the time elapsed for the vacuum to drop to 9" Hg.
   5. The manhole shall pass if the time is more than 60 seconds for 48" diameter, 75 seconds for 60" diameter and 90 seconds for 72" diameter manholes. Add an additional 15 seconds to the time requirement for every one-foot increase in manhole diameter over 72".

D. If the manhole fails the vacuum test, necessary repairs shall be made with an approved nonshrink grout while the vacuum is being drawn. Retesting as outlined above shall proceed until a satisfactory test is obtained.

E. If manhole joint mastic is completely pulled out during the vacuum test, the manhole shall be disassembled and the mastic replaced.

3.15 SEWER FORCE MAIN LEAKAGE TEST

A. All force mains and gravity ductile iron pipe sections closer than 10 feet parallel to potable water lines shall be pressure tested as per this Section.

B. Concurrently conduct a leakage test with the pressure test.

C. Leakage Defined: The quantity of water that must be supplied into the newly laid pipe to maintain the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.

D. Allowable Leakage
   1. Determine allowable leakage by:
      \[ L = \frac{(ND/P)}{7400} \]
      Where \( L \) is the allowable leakage, in gallons per hour; \( N \) is the number of joints in the tested pipeline; \( D \) is the nominal diameter of the pipe, in inches; and \( P \) is the average test pressure during the leakage test, in psi.
   2. Allow leakage at various pressures:
      Allowable Leakage per 1000 ft. of pipeline
   3. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.078 gal./hr./in. of nominal valve size shall be allowed.

E. Acceptance of Installation
   1. If any test of pipe laid discloses leakage greater than that specified above, locate and repair the defective material until the leakage is within the specified allowance.
   2. Repair all visible leaks regardless of the amount of leakage.
### Force Main Allowable Leakage

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* For Mechanical or push-on joint pipe with 18-ft. nominal lengths. To obtain the recommended allowable leakage for pipe with 20-ft. nominal lengths, multiply the leakage calculated from the above table by 0.9. If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each site.

#### 3.16 Combination Air Release Assemblies

A. A combination air release valve shall be placed at the necessary high points in the force main to prevent air locking.

B. Furnish in 2" nominal diameter, unless otherwise specified or shown on the Plans.

C. Install in an 18" Jumbo XL meter box for non-traffic areas, and metal box (or approved equal) for traffic areas.

D. Place crushed stone from the top of the main to 12" below the bottom of the main.

E. Combination air release assemblies shall consist of the following:
   1. Double strap, bronze service clamp with neoprene gasket (for PVC lines).
   2. Galvanized steel pipe of the nominal diameter required by the main size.
   3. Red brass corporation stop
   4. Galvanized steel elbow
   5. Gate valve
   6. An air and vacuum valve suitable for use in mains having a pressure of 200 psi.
   7. Shall be single body
   8. Shall be manufactured by A.R.I.

#### 3.17 Sewer Service Assemblies

A. Where shown on the Plans or located in the field, install fittings for individual service assemblies.
   1. Unless otherwise indicated on the Plans, the standard collector tap shall consist of a wye or tee connected with a 6 inch service branch.
2. Use vertical risers when the depth of the collector line is greater than 8 feet or when their use will facilitate connection of individual services.

3. Plug the ends of tee branches not to be used immediately with stoppers of the same material and joints used on the collector lines.

4. Provide flexible coupling for 6 inch diameter and larger services to manholes.

5. Provide a cleanout at the property line where one is not provided.

B. Where directed by the Engineer, install collector saddles by attaching to the sewer main by stainless steel bands secured by two bronze or stainless steel bolts with a minimum diameter of 3/8". Class I material should be hand-placed to support the saddle in order to prevent rotation during backfill.

C. Service pipe shall be a minimum of 6 inches in diameter and shall be installed as shown in the Plans.
   1. Plug the ends of service pipe and cover the same as for collectors and interceptors (where possible).
   2. The minimum grade on service pipes shall be one percent or 1/8" per foot.

D. Bed all sewer service assemblies in accordance with Section 31 23 00.

END OF SECTION 33 30 00
SECTION 33 40 00 - STORM DRAINAGE SYSTEMS

PART 1—GENERAL

1.01 WORK INCLUDED
A. Installation of storm drainage systems.

1.02 RELATED WORK
A. Section 31 23 00: Excavation and Fill.
C. Section 33 11 13: Separation of Piped Utilities.
D. Section 03 00 00: Concrete.

PART 2—PRODUCTS

2.01 CONCRETE PIPE (CP)
A. Culverts: AASHTO M-170 or ASTM C-76.
B. Elliptical culverts: AASHTO M-207 or ASTM C-507.
C. Reinforced low-head: ASTM C-361.

2.02 VITRIFIED CLAY PIPE (VCP)
A. Culverts: ASTM C-700, extra strength.

2.03 CORRUGATED POLYETHYLENE PIPE
A. AASHTO M294, Type S - Storm Sewers and Culverts.
B. AASHTO M-252 - Underdrains.
C. Circular or slotted perforations.
D. Flexible extruded pipe with circular or slotted perforations.
E. All HDPE pipe used for storm drain and culvert applications shall be certified through the Plastics Pipe Institute (PPI) Third Party Certification Program. All HDPE pipe delivered and used shall bear the Third Party Administered PPI seal.

2.04 CORRUGATED METAL PIPE (GALVANIZED) CULVERTS (CMP)
A. Corrugated Metal Pipe: AASHTO M-36, Type I.
B. Corrugated Metal Pipe Arches: AASHTO M-36, Type II.
C. Corrugated Metal Pipe Underdrains: AASHTO M-36, Type III. Unless otherwise specified, any of the classes covered may be furnished and shall be Type I pipe with circular or slotted perforations.
D. Structural Plate for Pipes, Pipe Arches, and Arches: AASHTO M-167 for galvanized corrugated structural plates and fasteners.

2.05 SMOOTH INTERIOR CORRUGATED PLASTIC PIPE (SICP)
A. Pipe shall be ADA N-12 WT IB pipe for use in gravity flow applications.
B. Pipe shall have a smooth interior and annular exterior corrugations.
C. Pipe shall meet the AASHTO M294, Type S or ASTM F 2306.
D. Pipe shall be joined with the N-12 WT IB joint meeting the requirements of AASHTO M294 or ASTM F 2306. Joint shall be watertight according to the requirements of ASTM D 3212. Gaskets shall meet the requirements of ASTM F 477. Gaskets shall be installed by the pipe manufacturer and covered with a removable wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.

E. Fittings shall conform to AASHTO M 294 or ASTM F 2306. Fabricated fittings shall be welded at all accessible interior and exterior junctions.

F. Pipe and fittings shall be made of virgin polyethylene compounds that comply with the cell classification 435400C for 12 inch through 60 inch diameters, as defined and described in ASTM D 3350, except that carbon black content should not exceed 4%.

2.06 CONCRETE MATERIALS

A. Structural concrete in accordance with Section 03 00 00.

2.07 BRICK

A. AASHTO M-91 or ASTM C-32 for the grade specified.

B. Clay or shale, Grade MS or MM.

C. Test brick by AASHTO T-32.

2.08 MASONRY CEMENT

A. AASHTO M-150, ASTM C-91.

B. Methods of sampling and testing of masonry cement, when required, shall be by the methods of AASHTO:

Sampling.........................T-127
Fineness..............................T-192
Normal Consistency..............T-129
Soundness.........................T-107
Time of Setting...................T-154
Specific Gravity..................T-133
Staining Test........................T-105
Compressive Strength............T-106
Plastic Consistency.............T-162
Air Content........................T-137
Mixing of Mortar..................T-162

C. Fine Aggregate: AASHTO M-45 consisting of hard, strong, durable uncoated mineral or rock particles free from injurious amounts of organic or other deleterious substances.

1. Sand for mortar shall be uniformly graded from coarse to fine within the following limits:

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<th>Sieve Size</th>
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2. Methods of test for fine aggregate, when required, shall be by the following methods of AASHTO:

- Sampling.....................................T-2
- Organic Impurities.....................T-21
- Mortar Making Properties........T-71
- Sieve Analysis..........................T-27
- Material Passing 200 Sieve.......T-11

D. Mix mortar in the following proportions:
   1. One part masonry cement.
   2. Two parts fine aggregate.
   3. Hydrated lime not exceeding 10 percent of the cement used.
   4. Water free of injurious substances, added to form a stiff workable paste.

2.09 CASTINGS FOR FRAMES, GRATES, AND COVERS

A. Gray Iron, Class 30, AASHTO M-108.
B. Bituminous paint finish not affected by hot or cold weather.

2.10 PRE-CAST POLYETHYLENE MANHOLES

A. ASTM D-1248
B. See Section 02722 for complete specifications.

2.11 PRE-CAST CONCRETE MANHOLES

A. AASHTO M-199 SR or ASTM C-478.
B. See Section 02722 for complete specifications.

2.11 WATER QUALITY DEVICE

A. Water quality device shall be as depicted on the construction drawings.

2.11 TRENCH DRAIN

A. Trench drain shall be as depicted on the construction drawings.

PART 3—EXECUTION

3.01 PREPARATION

A. Prior to laying pipe, prepare a suitable bedding according to Section 31 23 00.
B. Before placing pipe in the trench, field inspect for cracks or other defects; remove defective pipe from the construction site.
C. Swab the interior of the pipe to remove all undesirable material.
D. Prepare the bell end and remove undesirable material from the gasket and gasket recess.

3.02 INSTALLING STORM SEWER PIPE
STORM DRAINAGE SYSTEMS

3.03 CAST-IN-PLACE CONCRETE CATCHBASINS

A. Perform all concrete construction in accordance with Section 03 00 00.
B. Inverts: Class A concrete of the shapes indicated on the Plans and constructed to cause the least possible resistance to flow. The shape of the inverts shall conform uniformly to inlet and outlet pipes with a smooth and uniform finish.

3.04 BRICK CATCHBASINS

A. Do not construct brick masonry in freezing weather or when the bricks contain frost.
B. Select brick for exposed surfaces, corners, etc., from brick approved for color and uniformity.
C. All brick and the receiving bed shall be thoroughly cleaned and well moistened with water.
D. Lay all brick in freshly made mortar, in a substantial and workmanlike manner and true to the lines and grades indicated on the Plans.
E. Arrange headers and stretchers to thoroughly bond the masonry and, unless otherwise indicated or directed, alternate headers and stretchers with consecutive courses breaking joints.
F. Face joints shall be neatly struck, using the weather joint.
G. Finish joints properly as the laying of brick progresses with each not less than 1/4” nor more than 1/2” in thickness.
H. Do not use spalls or bats except in shaping around irregular openings or when unavoidable to finish out a course, in which case place a full brick at the corner and the bat in the interior of the course.
I. Filling materials for the interior of the walls shall be of the same quality as used in the face of the unit, unless otherwise indicated on the Plans.
J. The surface of brick masonry against which embankment or backfill is to be placed shall be neatly plastered with mortar to a thickness of not less than 1/2”, and the mortar shall be finished to a true and uniform surface. The mortar shall be protected and kept wet for 48 hours after completion.

3.05 CATCHBASIN—INLET AND OUTLET PIPES
A. Extend inlet and outlet pipes through the walls of catch basins for a sufficient distance beyond the outside surface to allow for connections, cut off flush with the wall on the inside surface, unless otherwise directed.
B. The concrete or brick and mortar shall be constructed around the pipes so as to prevent leakage and form a neat connection.

3.06 CASTINGS AND FITTINGS
A. Handle in a manner that will prevent damage. Reject all damaged castings and fittings.
B. Place all casting and fittings in the positions indicated on the Plans and set true to line and grade.
C. If castings are to be set in concrete or cement mortar, place all anchors or bolts and position before the concrete or mortar. The casting shall not be disturbed until the mortar or concrete has set.
D. When castings are to be placed upon previously constructed masonry, the bearing surface of masonry shall be brought true to line and grade and present an even bearing surface in order that the entire face or back of the casting will come in contact with the masonry. Castings shall be set in mortar beds or anchored to the masonry as indicated on the Plans.
E. All castings shall be set firm and snug and shall not rattle.

3.07 TRENCH DRAIN
A. Install trench drains in accordance with manufacturer’s recommendations.

3.08 WATER QUALITY DEVICE
A. Not applicable.

END OF SECTION 33 40 00
SECTION 33 50 00 - TEMPORARY BYPASS PUMPING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Under this item, the Contractor is required to furnish all materials, labor, equipment, power, and maintenance, etc. to implement a temporary pumping system for the purpose of diverting the existing flow around the work area, at locations specified in the Plans, for the duration of the project.

B. The design, installation, and operation of the temporary bypass pumping system shall be the Contractor’s responsibility. The temporary bypass pumping system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

1.02 REQUIREMENTS

A. The Contractor shall prepare a specific, detailed description of the proposed pumping system and submit it to the Engineer for approval prior to construction.

B. The Contractor shall submit to the Engineer detailed Plans and descriptions outlining all provisions and precautions to be taken by the Contractor regarding handling of existing wastewater flows. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials, and all other incidental items necessary and/or required to ensure proper protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in these Contract Documents. No construction shall begin until all provisions and requirements have been reviewed by the Owner.

C. The plan shall include but not be limited to the details of the following:
   1. Staging areas for pumps
   2. Sewer plugging method and types of plugs
   3. Size and location of manholes or access points for suction and discharge hose or piping
   4. Size of pipeline or conveyance system to be bypassed
   5. Number, size, material, location and method of installation of suction piping
   6. Number, size, material, method of installation and location of installation of discharge piping
   7. Bypass pump sizes, capacity, number of each size to be on site and power requirements
   8. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted)
   9. Standby power generator size, location
   10. Downstream discharge plan
   11. Method of protecting discharge manholes or structures from erosion and damage
   12. Thrust and restraint block sizes and locations
   13. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill
   14. Method of noise control for each pump and/or generator
   15. Any temporary pipe supports and anchoring requirements
   16. Design Plans and computation for access to bypass pumping locations indicated on the Drawings
   17. Calculations for selection of bypass pumping pipe size
   18. Schedule for installation of and maintenance of bypass pumping lines
   19. Plan indicating selection of location of bypass pumping line locations

1.03 EQUIPMENT
TEMPORARY BYPASS PUMPING

A. All pumps used shall be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system. The pumps may be electric or diesel powered. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of effluent flows.

B. The Contractor shall provide the necessary stop/start controls for each pump.

C. The Contractor shall include one stand-by pump of each size to be maintained on site. Back up pumps shall be online, isolated from the primary system by a valve.

D. It is recommended that the pump be contained inside a temporary portable berm to contain any fuel or sewage that may spill during the normal course of operation.

E. Discharge Piping – In order to prevent the accidental spillage of flows, all discharge systems shall be temporarily constructed of watertight pressure pipe such as HDPE or rigid pipe with positive, restrained joints. Under no circumstances will “irrigation” type piping or glued PVC pipe be allowed. Discharge hose will only be allowed in short sections and by specific permission from the Engineer.

1.04 SYSTEM REQUIREMENTS

A. Design Requirements:
Bypass pumping systems shall have sufficient capacity to pump peak flows as indicated on the Plans. The Contractor shall provide all pipeline plugs, pumps of adequate size to handle peak flow, and temporary discharge piping to ensure that the total flow of the main can be safely diverted around the section to be repaired. Bypass pumping systems will be required to be operated 24 hours per day.

1. The Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown. One standby pump for each size pump utilized shall be installed at the mainline flow bypassing locations, ready for use in the event of primary pump failure.

2. Bypass pumping system shall be capable of bypassing the flow around the work area and be sized to handle any amount of flow up to full available flow as defined by the customer into the work area as necessary for satisfactory performances of work.

3. The Contractor shall make all arrangements for bypass pumping during the time when the main is shut down for any reason. System must overcome any existence force main pressure on discharge.

B. Performance Requirements

1. It is essential to the operation of the existing system being bypassed that no interruptions in the flow occur throughout the duration of the project. To this end, the Contractor shall provide, maintain, and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), conduits, all necessary power, and all other labor and equipment necessary to intercept the incoming flow before it reaches the point where it would interfere with his work, carry it past the work area and return it to the existing system downstream of his work.

2. The design, installation and operation of the temporary pumping system shall be the Contractor’s responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

3. The Contractor shall provide all necessary means to safely convey the sewage past the work area. The Contractor will not be permitted to stop or impede the main flows under any circumstances.

4. The Contractor shall divert the flow around the work area in manner that will not cause damage to, or surcharging of customers system and will protect public and private property from damage and flooding.

5. The Contractor shall protect water resources, wetlands, and other natural resources.
1.05 FIELD QUALITY CONTROL AND MAINTENANCE

A. Testing: The Contractor shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to the actual operation. The Engineer will be given 24 hours notice prior to testing.

B. Inspection: Contractor shall inspect bypass pumping system on a continuous basis to ensure the system is working correctly.

C. Maintenance Service:
   1. Contractor shall ensure the temporary pumping system is properly maintained and a responsible operator shall be on hand at all times when pumps are operating.
   2. Contractor shall monitor pump fuel levels if required and make arrangements for timely refueling as needed

D. Extra Materials:
   1. Spare parts for pumps and piping shall be kept on site as required.
   2. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

1.06 PREPARATION

A. Precautions:
   1. Contractor is responsible for locating any existing utilities in the area selected for the bypass pipelines.
   2. The Contractor shall locate his bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the customer. All costs associated with relocating utilities and obtaining all approvals shall be paid by the Contractor.
   3. During all bypass pumping operations, the Contractor shall protect the customer’s system (Pumping Station, Conveyance System etc.) as applicable from damage inflicted by any equipment. The Contractor shall be responsible for all physical damage to the Customers system caused by human or mechanical failure.

1.07 INSTALLATION AND REMOVAL

A. The Contractor shall remove manhole sections or make connections to the existing conveyance system and construct temporary bypass pumping structures only at the access location indicated on the Drawings and as may be required to provide adequate suction conduit.

B. Plugging or blocking of flows shall incorporate a primary or secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance or work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.

C. When working inside manhole or force main, the Contractor shall exercise caution and comply with OSHA requirements when working in the presence of sewer gases, combustible or oxygen-deficient atmospheres, and confined spaces.

D. The installation of the bypass pipelines is prohibited in all salt marsh/wetland areas. The pipeline must be located if possible off streets and sidewalks and on shoulders of the roads. When the bypass pipeline crosses local streets and private driveways, the Contractor must place the bypass pipelines in trenches and cover with temporary pavement. Upon completion of the bypass pumping operations, and after receipt of written permission from the Customer, the Contractor shall remove all the piping, restore all property to pre-construction condition, and restore all pavement. The Contractor is responsible for obtaining any approvals for placement of the temporary pipeline from the Customer.
PART 2 PRODUCTS
(Not Used)

PART 3 EXECUTION
(Not Used)

END OF SECTION