FINE ARTS CLASSROOM BUILDING
FOR
EAST TENNESSEE STATE UNIVERSITY

East Tennessee State University
Johnson City, Tennessee

SBC NO. 166 / 005-08-2013

PROJECT MANUAL
FOR
100% DESIGN DEVELOPMENT SUBMITTAL

March 13, 2017

DESIGNERS
McCARTY HOLSAPLE McCARTY, INC.
ARCHITECTS & INTERIOR DESIGNERS
550 WEST MAIN STREET
SUITE 300
KNOXVILLE, TENNESSEE 37902
TEL: 865.544.2000
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CIVIL AND STRUCTURAL ENGINEERING
BEESON LUSK AND STREET, INC.
207 EAST MAIN STREET, SUITE 3C
JOHNSON CITY, TN 37604
TEL: 423 928-1175

MECHANICAL, PLUMBING, FIRE PROTECTION
ELECTRICAL, DATA/COMMUNICATIONS & SECURITY
Facilities Systems Consultants, LLC
713 SOUTH CENTRAL STREET, SUITE 101
KNOXVILLE, TN 37902
TEL: 865.246.0164

THEATER DESIGN
Theater Consultants Collaborative, Inc.
6600 MANOR HILL COURT
CHAPEL HILL, NC 72516
TEL 919 929-7443

LANDSCAPE ARCHITECTURE
The Penland Studio
111 NORTH CENTRAL STREET, SUITE 100
KNOXVILLE, TN 37902
TEL 865 335-3584

ACOUSTIC AND
AUDIOVISUAL
Acoustic Distinctions, Inc.
145 HUGUENOT STREET
NEW ROCHELLE, NY 10801
TEL 914 712-1300

COST ESTIMATING
Vermeulen’s, Inc.
470 ATLANTIC AVENUE, 4TH FLOOR
BOSTON, MA 02210
TEL 617 273-8430
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ARCHITECT
CIVIL ENGINEER
STRUCTURAL ENGINEER

PLUMBING ENGINEER
MECHANICAL ENGINEER
FIRE PROTECTION ENGINEER

ELECTRICAL ENGINEER
LANDSCAPE ARCHITECT

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<tr>
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<td>Structural Steel Erection</td>
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<td>Non-Composite (Inverted) Steel Floor Deck</td>
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<td>05.40.00</td>
<td>Cold Formed Steel Framing</td>
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<td>05.50.00</td>
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<td>05.51.10</td>
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<td>05.52.13</td>
<td>Pipe and Tube Railings</td>
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<td>05.53.05</td>
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<td>Roof Specialties</td>
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REQUEST FOR GMP

For Project:  
SBC #166/005-08-2013  
East Tennessee State University  
Fine Arts Classroom Building for East Tennessee State University

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:

☐ a new Contract.  
☒ an amendment to an existing Contract.

C. The GMP shall offer alternates as specified. In addition, voluntary alternates:

☐ may be proposed, up to ___________ 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:

☐ required, for an amount equal to the base bid  
☒ 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>?? days</td>
<td>??</td>
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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**
MAP TO THE BID OPENING LOCATION
in Tri-Cities

Bids sent by mail should be directed to the attention of
Barbi Worley, Business Manager
ETSU Facilities Management Office
P. O. Box 70653
Johnson City, Tennessee 37614

(423) 439 - 7767

Bids will be received at:
The Physical Plant
Wilbur Bond Maintenance Building
East Tennessee State University
Johnson City, Tennessee 37614

East Tennessee State University (ETSU) is in Johnson City, about 1.3 km west-southwest of the downtown Courthouse, and about 3.0 km west-southwest of City Hall. The Physical Plant is about 1.1 km further west-southwest, on the far side of campus from downtown.

Suggested route
from I-181 through Johnson City:

• Take I-181 South to Exit 31, which ramps right and makes a half-circle.
• Turn left (southwest) onto University Parkway. This completes a net right turn from I-181. Proceed about 2.5 km.
• Turn left into J. I. Seehorn Drive (formerly Southwest Avenue), on the south perimeter of ETSU campus. Proceed about 0.8 km.
• Turn right (northwest) at 2nd 4-way Stop onto John Robert Bell Drive (formerly University Drive).
• Turn left (southwest) at first street, which is a divided boulevard known as Dossett Drive. Proceed about 0.4 km.
• As Dossett Drive begins to curve right around Lucille Clement Hall, continue straight into student parking area.
• The Physical Plant
(Wilbur Bond Maintenance Building) is approached via a driveway on the south side of the student parking area.

Free Visitor Parking is available in front of the Physical Plant. Additional parking is available in an undesignated lot extending west of the student parking lot.
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
1 Bridgestone Park
Nashville, Tennessee 37214-2428

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 1 Bridgestone Park 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

<table>
<thead>
<tr>
<th>Name</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rilla Froggatt</td>
<td>615-366-3908</td>
<td><a href="mailto:rilla.froggatt@tbr.edu">rilla.froggatt@tbr.edu</a></td>
</tr>
<tr>
<td>Cindy Potts</td>
<td>615-366-4431</td>
<td><a href="mailto:cindy.potts@tbr.edu">cindy.potts@tbr.edu</a></td>
</tr>
<tr>
<td>Tammy Ray</td>
<td>615-366-4493</td>
<td><a href="mailto:tammy.ray@tbr.edu">tammy.ray@tbr.edu</a></td>
</tr>
</tbody>
</table>

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.

END OF SECTION
# GMP SUMMARY

**Project:** 166/005-08-2013 Fine Arts Classroom Building for East Tennessee State University

**Presented by CM/GC:** Denark Construction, Inc.

<table>
<thead>
<tr>
<th></th>
<th>Base Work</th>
<th>Specified Alternates</th>
<th>Volunteered Alternates</th>
<th>Total if all accepted</th>
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<tbody>
<tr>
<td>date</td>
<td></td>
<td>#1</td>
<td>#2</td>
<td>#3</td>
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<tr>
<td>fixed fee percentage</td>
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<tr>
<td>contingency percentage</td>
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| Allowances | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Estimates   | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Hard Bids   | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| 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):
contgcy (% of trades,GCs,Self):
fee (% of GMP):
# GMP List of Trade Subcontracts
## 00 42 71 - 1

### Project:
166/005-08-2013 Fine Arts Classroom Building for East Tennessee State University

### Presented by CM/GC:
Denark Construction, Inc.

<table>
<thead>
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<th>Specified Alternates</th>
<th>Volunteered Alternates</th>
<th>Total if all accepted</th>
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## GMP DISCLOSURE OF GENERAL CONDITIONS

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<thead>
<tr>
<th>SBC Project Number</th>
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<th>Owner: Tennessee Board of Regents</th>
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</thead>
<tbody>
<tr>
<td>TBR Institution</td>
<td>East Tennessee State University</td>
<td>CM/GC: Denark Construction, Inc.</td>
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### General Conditions Costs

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<tr>
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<th>Original Proposal</th>
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<tr>
<td>Asst Superintendent</td>
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<td>Project Manager</td>
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<td>Project Director</td>
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<tr>
<td>Project Engineer / Safety</td>
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<tr>
<td>Layout Instruments</td>
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<tr>
<td>Temporary Office Trailer</td>
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<tr>
<td>Temporary Storage Trailer</td>
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<td>Phones &amp; Beepers</td>
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<td>Safety Measures</td>
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<td>Permits</td>
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<td>Builder's Risk Insurance</td>
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<td>Other Insurance (explain)</td>
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<td>Bond</td>
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<td>Gross Receipts Tax</td>
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</tr>
<tr>
<td>Signs</td>
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<tr>
<td>Other Temporary stuff</td>
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<td>Misc Printing</td>
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<tr>
<td><strong>Total</strong></td>
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</tbody>
</table>
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 VOIDED 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.: ____________________________________

FA-0825 (Rev. 4/96)

FOR STATE USE ONLY:
CONTACT AGENCY – ____________________________ CONTACT PERSON – ____________________________
PHONE NUMBER – ____________________________
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.
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.
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.
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           (countersignature of resident Agent if not same as Attorney-in-fact)
   if not same as Attorney-in-fact)

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GENERAL CONDITIONS TO THE CONTRACT – PLACE HOLDER
SECTION 00.72.13
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

Add the following section:

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

11.1.1.5 Delete “other than to the Work itself”.

Add the following section:

11.1.2.6 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.”

11.3.1.1 Delete the last two sentences and substitute, “Any deductibles shall be the responsibility of the Contractor.”

11.3.1.2 Delete this section.

11.3.1.4 Delete the clause in its entirety and substitute: This property insurance shall cover portions of the work stored off the site and also portions of the work in transit. The Contractor shall present a certificate of insurance demonstrating coverage of the property stored off the site or in transit at the time payment for that portion of the work is presented.

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
1.01 PROJECT
A. Project Name: Fine Arts Classroom Building
B. Owner's Name: Tennessee Board of Regents.
C. Architect's Name: McCarty Holsaple McCarty Architects, Inc.
D. The Project consists of the construction of Fine Arts performance building including but not limited to classrooms, musical practice spaces, performing and supporting spaces. Work includes, but is not limited to sitework, structural, masonry, structural steel, HVAC, plumbing, fire protection, electrical power, communications, security, audio-visual and acoustic treatments.

1.02 CONTRACT DESCRIPTION
A. Contract Type: A Construction Manager At Risk contract.

1.03 OWNER OCCUPANCY
A. Owner intends to occupy the Project upon Substantial Completion.
B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
C. Schedule the Work to accommodate Owner occupancy.

1.04 CONTRACTOR USE OF SITE
A. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.

1.05 SPECIFICATION SECTIONS APPLICABLE TO ALL CONTRACTS
A. Unless otherwise noted, all provisions of the sections listed below apply to all contracts. Specific items of work listed under individual contract descriptions constitute exceptions.
   B. Section 01.21.13 - Allowances.
   C. Section 01.23.00 - Alternates.
   D. Section 01.30.00 - Administrative Requirements.
   E. Section 01.33.29 - Sustainable Design Reporting.
   F. Section 01.40.00 - Quality Requirements.
   G. Section 01.50.00 - Temporary Facilities and Controls.
   H. Section 01.60.00 - Product Requirements.
   I. Section 01.70.00 - Execution and Closeout Requirements.
   J. Section 01.78.00 - Closeout Submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01.10.00
PART 1 - GENERAL

1.01 Include in Contract Sum the allowances stated in Contract Documents. Designate in construction progress schedule the delivery dates for products specified under each allowance.

1.02 Refer particularly to Conditions section 3.8 for inclusions and exclusions not specified below.

1.03 Administration of allowances

A. Contractor’s duties in selection of products under allowances
   1. Assist the Designer and Owner in determining qualified suppliers or installers.
   2. Obtain bids from suppliers and installers when requested by the Designer.
   3. Make appropriate recommendations for consideration of the Designer.
   4. Notify the Designer promptly of:
      a. Reasonable objections against a supplier, or party under consideration for installation.
      b. Effect on the Construction Schedule anticipated by selections under consideration.

B. Adjustment of costs
   1. Continuously monitor the use of each allowance and the anticipated use to complete the Work. Do not exceed an allowance.
   2. If an allowance is at risk of being exceeded, request a modification to increase the allowance 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.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES the list of allowances that, in addition to quantity allowances that may be specified for Unit Price items, are as follows:

A. Design Development Pricing Costs Included in Cash Allowances: Cost of product to Contractor or subcontractor, less applicable trade discounts, less applicable taxes.

B. Costs Not Included in Cash Allowances: Product delivery to site and handling at the site, including unloading, uncrating, and storage; protection of products from elements and from damage; and labor for installation and finishing.

1.02 DESIGN DEVELOPMENT ALLOWANCES SCHEDULE

A. Section 12.61.00 – Fixed Audience Seating: Include the stipulated sum of $250.00 per seat for the purchase of fixed seats.

PART 2 – PRODUCT – NOT USED
PART 3 – EXECUTION – NOT USED

END OF SECTION
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:
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Option 1 Parking at Northwest Corner of the Site:
   2. Design Option (Add): Include additional 25 parking spaces as dashed in on Site Layout Plan C101.

B. Option 2 Fixed Seating Allowance:
   1. Base costs: Per section 01.21.00 Allowances, $250.00 per seat for fixed audience seats.
   2. Design Option (Add): Allow $400.00 per seat for fixed audience seats.

C. Option 3 Site work at the Corner of Franklin Road and W. Harris Drive.
   1. Base costs: No improvement work in the area, per Design Development drawings C101 and L101.
   2. Design Option (Add): Add sidewalk and landscape improvement south of Bank property for streetscape continuity and access from parking garage across from the street.

D. Option 4 Generator and Automatic Transfer Switch
   1. Base Costs: No generator or Automatic Transfer Switch as shown on the Electrical Design Development drawings
   2. Design Option (Add): Provide Generator set and Automatic Transfer Switch as specified in sections 23.32.13 – Generator Set and 26.36.00 – Automatic Transfer Switch.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION 01.23.11
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
# SECTION 01 25 33

## PRODUCT SUBSTITUTION REQUEST FORM

<table>
<thead>
<tr>
<th>To:</th>
<th>Project:</th>
</tr>
</thead>
<tbody>
<tr>
<td>McCarty Holsaple McCarty, Architects, Inc.</td>
<td>166/005-08-2013</td>
</tr>
<tr>
<td></td>
<td>Fine Arts Classroom for East Tennessee State University</td>
</tr>
</tbody>
</table>

### Specified Item:

### Proposed Substitute:

1. The following are attached (Mark all that apply):
   - [ ] Complete Description
   - [ ] Laboratory Tests
   - [ ] Information on the availability of maintenance services and replacement materials for proposed substitute(s)
   - [ ] Catalog
   - [ ] Spec Data
   - [ ] 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
   - [x] 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
   - [x] 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:
   - Sign here: ______________________
   - Name: __________________________
     type or print: _____________________
     for: _____________________________
   - Telephone: _______________________
   - 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: ___________________________
SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

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:

<table>
<thead>
<tr>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
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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
### SECTION 01 26 25
**WEATHER DELAY REPORT**

<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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</table>

**SBC Project Number and Project Name**

166/005-08-2013
Fine Arts Classroom for East Tennessee State University

**Month and Year reported below**

<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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</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  Modification
[ ] Change Order  Number:
[ ] Construction Change Directive

PROJECT: Fine Arts Classroom for East Tennessee State University

Original Contract Date:
This Change initiated:

Project Number 166/005-08-2013

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 ....................

<table>
<thead>
<tr>
<th>CONTRACTOR</th>
<th>DESIGNER</th>
<th>OWNER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signed</td>
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<tr>
<td>Name &amp; Date</td>
<td>Name &amp; Date</td>
<td>Name &amp; Date</td>
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<tr>
<td>For</td>
<td>For</td>
<td>For</td>
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Form for Amendment, Change Order, or Directive
Jun 05 OFD 012640 Page 1 of 1
**SECTION 01 26 54**  
**FORM FOR PRICE SUMMARY**

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>Fine Arts Classroom for East Tennessee State University</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBC Project Number:</td>
<td>166/005-08-2013</td>
</tr>
<tr>
<td>Name of General contractor:</td>
<td>Denark Construction, Inc.</td>
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<table>
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<th>Proposal Number:</th>
<th>Date Itemized:</th>
<th>Page of pages</th>
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</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>
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</table>

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.

**Subtotal:** 0.00

General Contractor mark-up on Subtotal: % = 0.00

Subtotal for General Contractor for work by subcontractors: 0.00

**Work by General Contractor**

Subtotal (including Subcontractors and the General Contractor): 0.00

Bond Premium: % = 0.00

**Total:** 0.00
### SECTION 01 26 55
**FORM FOR PRICE OF WORK**

**SBC Project Number:** 166/005-08-2013  
**Project Name:** Fine Arts Classroom for East Tennessee State University

Work itemized below provided by:

<table>
<thead>
<tr>
<th>Description</th>
<th>Material</th>
<th>Equipment</th>
<th>Labor</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</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.

*Posted in XLS format*  
*July 2012 OFD s012655*  
*Page 1 of 1*
<table>
<thead>
<tr>
<th>Description</th>
<th>Period Cost</th>
<th>Period (Year, Month, Week, Day)</th>
<th>Cost Per Day</th>
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<td>Copier</td>
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<td>Typewriter</td>
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<tr>
<td>Calculator</td>
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</tr>
<tr>
<td>Field Office Utilities</td>
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<tr>
<td>Electricity</td>
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<tr>
<td>Natural Gas</td>
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<tr>
<td>Drinking Water</td>
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</tr>
<tr>
<td>Telephone Service</td>
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<td></td>
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</tr>
<tr>
<td>On-Site Storage</td>
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<td></td>
<td></td>
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<tr>
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<tr>
<td>Trailer</td>
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<tr>
<td>Safety Program</td>
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</tr>
<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: 

Cells with red underline (if viewed in color) are for you to fill in. Other cells are protected. Math functions show rounded to penny, but carry exact value for calculations. Let embedded math do its work. Use "Year", "Month", "Week", or "Day" for period. This XLS spreadsheet is available on the Owner's website, Designers' Manual, Bidding Documents, listed by its Section number and Title.
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
# SECTION 01 29 17
## FORM FOR CM/GC GMP CONTINGENCY LOG

<table>
<thead>
<tr>
<th>CM/GC name: Denark Construction, Inc</th>
<th>Owner's project number: 166/005-08-2013</th>
<th>Project Name: Fine Arts Classroom for East Tennessee State U</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Credit</th>
<th>Charge</th>
<th>Remaining Contingency</th>
<th>Comment</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>0.00</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Posted in XLS format
General Work for CM/GC
March 2012 OFD s012917 page 1 of 1


<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>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Current Reserve: 0.00
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 …
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,

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) to be its 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) ________________________________

PHONE NUMBER ________________________________

PLEASE PRINT
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
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>Consent of Surety with Power of Attorney</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>no</td>
<td>YES</td>
<td>Data Binder Receipt(s)</td>
</tr>
<tr>
<td>copy</td>
<td>yes</td>
<td>if any</td>
<td>if any</td>
<td>Roof Warranty or warranties</td>
</tr>
<tr>
<td>copy</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>Report of Subcontractors and Suppliers</td>
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<tr>
<td>copy</td>
<td>YES</td>
<td>if any</td>
<td>if any</td>
<td>Visitor Log</td>
</tr>
<tr>
<td>copy</td>
<td>YES</td>
<td>if any</td>
<td>if any</td>
<td>Weather Delay Report</td>
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<tr>
<td>copy</td>
<td>YES</td>
<td>no</td>
<td>YES</td>
<td>Progress Schedule</td>
</tr>
<tr>
<td>copy</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>Submittal Log</td>
</tr>
</tbody>
</table>

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 SECTION INCLUDES
   A. Electronic document submittal service.
   B. Progress photographs.
   C. Coordination drawings.
   D. Submittals for review, information, and project closeout.
   E. Number of copies of submittals.
   F. Submittal procedures.

1.02 RELATED REQUIREMENTS
   A. Document 00.72.00 - General Conditions: Dates for applications for payment.
   B. Document 00.72.00 - General Conditions: Duties of the Construction Manager.
   C. Document 00.73.16 - Supplementary Conditions: Duties of the Construction Manager
   D. Section 01.91.13 - Commissioning: Additional procedures for submittals relating to commissioning.

1.03 PROJECT COORDINATION
   A. Project Coordinator: Construction Manager.
   B. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for on site access, traffic, and parking facilities.
   C. During construction, coordinate use of site and facilities through the Project Coordinator.
   D. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
   E. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities.
   F. Coordinate field engineering and layout work under instructions of the Project Coordinator.
   G. Make the following types of submittals to Architect through the Project Coordinator:
      1. Requests for interpretation.
      2. Requests for substitution.
      3. Shop drawings, product data, and samples.
      4. Test and inspection reports.
      5. Design data.
      6. Manufacturer's instructions and field reports.
      7. Applications for payment and change order requests.
      8. Progress schedules.
      9. Coordination drawings.
      10. Correction Punch List and Final Correction Punch List for Substantial Completion.
      11. Closeout submittals.
PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE
A. See Section 01.33.29 - Sustainable Design Reporting for electronic submittal service for sustainable design documentation.
B. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF) format and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
   1. Besides submittals for review, information, and closeout, this procedure applies to requests for information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
   2. Contractor and Architect are required to use this service.
   3. It is Contractor's responsibility to submit documents in PDF format.
   4. Subcontractors, suppliers, and Architect's consultants are to be permitted to use the service at no extra charge.
   5. Users of the service need an email address, Internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
   6. Paper document transmittals will not be reviewed; emailed PDF documents will not be reviewed.
   7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
C. Cost: The cost of the service is to be paid by Contractor; include the cost of the service in the contract sum.
D. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
   1. Representatives of Owner are scheduled and included in this training.
E. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.02 PROGRESS PHOTOGRAPHS
A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
B. Maintain one set of all photographs at project site for reference; same copies as submitted, identified as such.
C. Photography Type: Digital; electronic files.
D. Provide photographs of site and construction throughout progress of Work produced by an experienced photographer, acceptable to Architect.
E. In addition to periodic, recurring views, take photographs of each of the following events:
   1. Completion of site clearing.
   2. Excavations in progress.
   3. Foundations in progress and upon completion.
   4. Structural framing in progress and upon completion.
   5. Enclosure of building, upon completion.
F. Views:
   1. Provide aerial photographs from four cardinal views at each specified time, until structure is enclosed.
   2. Provide non-aerial photographs from four cardinal views at each specified time, until Date of Substantial Completion.
   3. Consult with Architect for instructions on views required.
   4. Provide factual presentation.
   5. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.

G. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
   1. Delivery Medium: Via email.
   2. File Naming: Include project identification, date and time of view, and view identification.
   3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
   4. Photo CD(s): Provide 1 copy including all photos cumulative to date and PDF file(s), with files organized in separate folders by submittal date.

3.03 COORDINATION DRAWINGS
   A. Provide information required by Project Coordinator for preparation of coordination drawings.
   B. Review drawings prior to submission to Architect.

3.04 SUBMITTALS FOR REVIEW
   A. When the following are specified in individual sections, submit them for review:
      1. Product data.
      2. Shop drawings.
      3. Samples for selection.
      4. Samples for verification.
   B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
   C. Samples will be reviewed only for aesthetic, color, or finish selection.
   D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01.78.21 - Closeout Submittals.

3.05 SUBMITTALS FOR INFORMATION
   A. When the following are specified in individual sections, submit them for information:
      1. Design data.
      2. Sustainable Design Guidelines submittals and reports.
      3. Certificates.
      4. Test reports.
      5. Inspection reports.
      6. Manufacturer's instructions.
      7. Manufacturer's field reports.
      8. Other types indicated.
   B. Submit for Architect's knowledge as contract administrator or for Owner. No action will be taken.

3.06 SUBMITTALS FOR PROJECT CLOSEOUT
   A. Submit Correction Punch List for Substantial Completion.
   B. Submit Final Correction Punch List for Substantial Completion.
C. When the following are specified in individual sections, submit them at project closeout:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

3.07 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

3.08 SUBMITTAL PROCEDURES

A. Shop Drawing Procedures:
   1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related Work.
   2. Do not reproduce the Contract Documents to create shop drawings.
   3. Generic, non-project specific information submitted as shop drawings do not meet the requirements for shop drawings.

B. Transmit each submittal with a copy of approved submittal form.

C. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.

D. Identify Project, SBC Number, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.

E. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.

F. Schedule submittals to expedite the Project, and coordinate submission of related items.

G. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.

H. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.

I. Provide space for Contractor and Architect review stamps.

J. When revised for resubmission, identify all changes made since previous submission.

K. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.

L. Submittals not requested will not be recognized or processed.

END OF SECTION 01.30.00
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
SECTION 01 31 90
ADMINISTRATIVE LOGS

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.

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</table>
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
PART 1  GENERAL

1.01  PROJECT GOALS
   A. Contractor is not responsible for the application for certification, nor for determination of methods of achieving sustainable design credits unless specifically so indicated.
   B. Many of the sustainable design credits can be achieved only through intelligent design of the project and are beyond the control of the Contractor. However, certain credits relate to the products and procedures used for construction. Therefore, the full cooperation of the Contractor and subcontractors is essential to achieving final certification.
   C. Contractor shall familiarize himself with the relevant requirements and provide the necessary information and instruction to all subcontractors and installers.
   D. Since Contractor and subcontractors may not be familiar with sustainable design requirements, this section includes a summary of the products and procedures intended to achieve sustainable design credits.
      1. Some credits are dependent on proper performance by Contractor and subcontractors.
      2. Other credits involve quantifying percentages by weight or volume and cost; these require careful recordkeeping and reporting by the Contractor.

1.02  RELATED REQUIREMENTS
   A. ETSU Fine Arts Classroom Building Sustainable Design Guidelines CHECKLIST/TRACKING FORM at end of this section.

1.03  SUBMITTALS
   A. Sustainable Design Documentation: The scope of required documentation is specified in some individual specification sections; other scope is specified in this section and its related forms only.
   B. New Product Documentation: For each new product in the Product Reporting Scope, submit the Material Content Form, with evidence of compliance attached.
   C. Product Cost Statement: Submit the total cost of all products defined as in the Product Reporting Scope, above, including purchase price, taxes, and delivery to site, but not labor, tools, or equipment for installation; submit prior to or along with initial application for payment; update and re-submit whenever the total cost changes due to contract modifications.

PART 2  PRODUCTS  (NOT USED)

PART 3  EXECUTION  (NOT USED)

END OF SECTION 01.33.29
### High Performance Building Requirements v1.01

**CHECKLIST / TRACKING FORM**

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#### Primary Credit Responsibility

- **ME - Mechanical Engineer**
- **EE - Electrical Engineer**
- **CE - Civil Engineer**
- **A - Architect**
- **O - Owner**
**Role:** A - Architect, ME - Mechanical Engineer, EE - Electrical Engineer, SBC - Sustainable Building Consultant, Other - Other

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**Comment:** Describe implementation approach for priority 1 and 2 credits. Provide justification for priority 3 credit.

**High Performance Building Requirements Checklist:**

**Project Name:** ETSU Fine Arts Classroom Building

**Project Type:** New Construction

**Project Phase:** Schematic Design

**Date:** 11/9/2016

**SBC Number:** 166/005-08-2013

**Targeted Points**

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**Comment:** Describe implementation approach for priority 1 and 2 credits. Provide justification for priority 3 credit.

**Related Credits:**

- Water Efficient Irrigation
- Water Use Reduction
- Wastewater Treatment & Conveyance
- Waste Reduction
- Water Use Reduction
- Water Efficient Landscaping
- Water Use Reduction

**Comment:** Provide justification for priority 3 credit.

**High Performance Building Requirements Checklist:**

**Project Name:** ETSU Fine Arts Classroom Building

**Project Type:** New Construction

**Project Phase:** Schematic Design

**Date:** 11/9/2016

**SBC Number:** 166/005-08-2013

**Targeted Points**

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**Possible Points**

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<td>WE 1.30</td>
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</table>

**Comment:** Describe implementation approach for priority 1 and 2 credits. Provide justification for priority 3 credit.

**Related Credits:**

- Water Efficient Irrigation
- Water Use Reduction
- Wastewater Treatment & Conveyance
- Waste Reduction
- Water Use Reduction
- Water Efficient Landscaping
- Water Use Reduction

**Comment:** Provide justification for priority 3 credit.
## High Performance Building Requirements v1.01

### Checklist / Tracking Form

**Owner**

**Targeted Points**

**Phase**

**Project Name**

**Applicable Credit**

**Not Attempted**

**ME - Mechanical Engineer**

**EE - Electrical Engineer**

**CE - Civil Engineer**

**A - Architect**

**Minimum Possible Points**

**Priority**

**Comment:** Describe implementation approach for each pursued credit. If credits are not pursued, justify. Resultant energy saving measures could add construction cost, but generally these are tweaks with good energy performance impact. If credits are not pursued, justify. Resultant energy saving measures could add construction cost, but generally these are tweaks with good energy performance impact.

### Energy Efficiency

<table>
<thead>
<tr>
<th>Description</th>
<th>Level</th>
<th>Required</th>
<th>Priority</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
<td>Commissioning - Advanced commissioning process</td>
<td>Required</td>
<td>1</td>
<td>3</td>
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<tr>
<td>Energy Efficient Building Code - energy code for all buildings</td>
<td>Required</td>
<td>1</td>
<td>3</td>
<td></td>
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<tr>
<td>Energy Efficient - Life Cycle Cost Analysis</td>
<td>Priority</td>
<td>1</td>
<td>3</td>
<td></td>
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<tr>
<td>Renewable Energy - on-site renewable energy projects</td>
<td>Required</td>
<td>1</td>
<td>3</td>
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<tr>
<td>Energy Star qualified appliances &amp; equipment</td>
<td>Required</td>
<td>1</td>
<td>3</td>
<td></td>
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<tr>
<td>Energy Efficient Purchasing Policy</td>
<td>Required</td>
<td>1</td>
<td>3</td>
<td></td>
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<tr>
<td>Energy Efficiency - Advanced Lighting Power Reduction</td>
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<td>Life Cycle Cost Analysis</td>
<td>Priority</td>
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<td>3</td>
<td></td>
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<tr>
<td>Energy Star Portfolio Manager</td>
<td>Required</td>
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<tr>
<td>Provide Renewable Energy Credits (RECs) equal to 10% of annual site electricity through TVA or RECs equal to 35% from another source</td>
<td>Required</td>
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### Long-Term Energy Reporting

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<th>Comments</th>
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<td>Energy Monitoring, Measuring and Reporting</td>
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<tr>
<td>Long-Term Energy Reporting</td>
<td>Required</td>
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<td>3</td>
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<tr>
<td>Renewable Energy Sources - carbon dioxide equivalent annual greenhouse gas emissions</td>
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### Other

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<tbody>
<tr>
<td>Other</td>
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**Checklist Total:**

**Primary Credit Responsibility:**

**Initials:**

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**Print Date: 11/28/2016 8:40 AM**
### Checklist / Tracking Form

**Phase** | **Targeted Points** | **Applicable** | **Not Applicable** | **Project Name** | **Project Type** | **Project Phase** | **Date** | **Applicable Credit Attempted** | **Applicable Credit Not Attempted** | **Project Team Representatives** | **Initials**
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
SD | 32 | 0 | 0 | ETSU Fine Arts Classroom Building | New Construction | Schematic Design | 11/9/2016 | Yes | No | Contractor | C

### Checklist Total

<table>
<thead>
<tr>
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<th>Role</th>
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<tbody>
<tr>
<td>Recycling Collection and Storage</td>
<td>Yes</td>
<td>MRM</td>
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<tr>
<td>Construction Waste Management (50%, 75%, 95%)</td>
<td>Required</td>
<td>Priority 1</td>
</tr>
<tr>
<td>Sustainable Materials: Recycled content 10%</td>
<td>Required</td>
<td>Priority 2</td>
</tr>
<tr>
<td>Sustainable Materials: Recycled content 20%</td>
<td>Required</td>
<td>Priority 2</td>
</tr>
<tr>
<td>Sustainable Materials: Tennessee Produced Materials (non-wood) - Harvested AND manufactured in state - 10% of total cost. Harvested OR manufactured in TN, 50% of product cost contributes to credit.</td>
<td>Required</td>
<td>Priority 2</td>
</tr>
<tr>
<td>Sustainable Materials: Tennessee Produced Wood Products - Wood materials harvested AND manufactured in state - 50% of wood products. When harvested OR manufactured in state, 50% of material cost contributes to credit.</td>
<td>Required</td>
<td>Priority 2</td>
</tr>
<tr>
<td>Regional materials - 20%</td>
<td>Required</td>
<td>Priority 2</td>
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<tr>
<td>Material reuse</td>
<td>Required</td>
<td>Priority 2</td>
</tr>
<tr>
<td>Rapidly renewables</td>
<td>Required</td>
<td>Priority 2</td>
</tr>
</tbody>
</table>
## Checklist / Tracking Form

### High Performance Building Requirements v1.01

**Project Name:** ETSU Fine Arts Classroom Building  
**Date:** 11/9/2016

### Owner

- **SBC Number:** 166/005-08-2013
- **Applicable Credit Attempted:**
  - C - Contractor
  - E - Electrical Engineer
  - M - Mechanical Engineer
  - A - Architect

### Contractor

- **Project Name:** ETSU Fine Arts Classroom Building
- **Applicable Credit Attempted:**
  - SD 45
  - DD 0
  - CD 0
  - Closeout 0

### Other

- **Applicable Credit Not Attempted:**
  - ME - Mechanical Engineer

### Applicable Credit Not Attempted

- **Applicable Credit:**
  - ME - Mechanical Engineer

### Minimum Credits

- **Project Type:** New Construction
- **Project Phase:** Schematic Design

### Credits

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<th>Possible Points</th>
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<th>Applicable to Building/Site Scope?</th>
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<td>19 Points</td>
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<td>Indoor Environmental Quality</td>
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<td>1</td>
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<td></td>
<td>Tobacco Smoke Control</td>
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<tr>
<td>2</td>
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<td>Minimum Ventilation: Design to meet ASHRAE 62.1-2007 or 2012 IMC</td>
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<td>3</td>
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<td>Outdoor Air Delivery Monitoring: Provide a direct outdoor airflow measurement device</td>
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<td>4</td>
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<td>CO2 Monitoring: Provide CO2 monitors in all high occupancy areas</td>
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<td>Air Quality Management: During construction</td>
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<td>Air Quality Management: Before occupancy</td>
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<td>Material VOC Limits: Adhesives and sealants</td>
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<td>Material VOC Limits: Coatings and anti-corrosive paints</td>
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<td>Material VOC Limits: Roofing systems</td>
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<td>11</td>
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<td>Material VOC Limits: Composite wood and agilFloor</td>
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<td>Thermo Comfort: Design to meet ASHRAE Standard 55-2004</td>
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<td>Individual Occupant System Controls: Lighting controls</td>
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<td>Individual Occupant System Controls: Thermal comfort</td>
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<td>Daylight to Occupied spaces</td>
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<td>19</td>
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<td>Views from Occupied spaces</td>
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</table>

- **Comment:** Describe implementation approach for each pursued credit. If credits are not pursued, provide justification.

### Issues

- **EE - Electrical Engineer**
  - FSC - Code Required

- **ME - Mechanical Engineer**
  - FSC - Equipment needs space, cost for instrumentation and connection to BAS

- **A - Architect**
  - Owner: Verify

- **Owner**
  - FSC - Equipment needs space, cost for instrumentation and connection to BAS

### Notes

- **Comment:**
  - FSC: Filtration media may take up extra space depending on equipment used. This could be a bigger factor than cost.

### Print Date

- **Print Date:** 11/28/2016 8:40 AM

---

**State of Tennessee HPBr v1.01 12/18/2015**

---

**Page 5 of 6**
**High Performance Building Requirements v1.01**

**CHECKLIST / TRACKING FORM**

<table>
<thead>
<tr>
<th>Phase</th>
<th>SBC Number</th>
<th>Project Name</th>
<th>Date</th>
<th>Project Phase</th>
<th>Category from Applicability Tree</th>
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**Project Phase**
- **Schematic Design**
- **Programming**
- **Civil Engineering**
- **Mechanical Engineering**
- **Electrical Engineering**
- **Architect**
- **Other**

**Minimum Points**
- 43

**Credit Attempted**
- Owner
- Contractor
- Architect

**Credit Not Attempted**
- Mechanical Engineer
- Electrical Engineer
- Civil Engineer

**Applicable Credit**
- Owner
- Contractor
- Architect

**Not Applicable Credit**
- Mechanical Engineer
- Electrical Engineer
- Civil Engineer

**Checklist Total**
- 49

**Possible Points**
- Innovation in Design: Provide Specific Title
- Environmentally Accredited Design Team

**Comment**
- Describe implementation approach for each pursued credit. If credits are not pursued, provide justification.

<table>
<thead>
<tr>
<th>Possible Points</th>
<th>Credit ID</th>
<th>Applicable to Building Site Scope?</th>
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<th>Primary Credit Responsibility</th>
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<td>Priority 2</td>
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<td>ID 1.4</td>
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<td>Priority 1</td>
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<td>5</td>
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<td>Yes</td>
<td>Environmentally Accredited Design Team</td>
<td>Priority 1</td>
<td>Several Design Team Leaders</td>
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**Checklist Total:** 46 9 49 10 49 0 0 104 0 0 104 0 0 104
## 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>Document</th>
<th>Source</th>
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</thead>
<tbody>
<tr>
<td>2. NFPA 101 Life Safety Code, 2012 No provision of the preceding cited publications shall be adopted that conflicts: The installation and service standards of portable fire extinguishers and fixed fire extinguisher systems in Tenn. Comp. R. &amp; Regs. 0780-02-14-.02; and, The standards for engaging in the liquefied petroleum gas business in Tenn. Comp. R. &amp; Regs. 0780-02-17-.02. Paragraph (1) of this rule shall not be constructed as adopting any provision of the cited publications which establishes: and optional or recommended, rather than mandatory, standard or practice; or, any agency, procedure, fees or penalties for administration or enforcement purposes inconsistent with the statute or rules. 2008 National Electrical Code</td>
<td>National Fire Protection Association 1 Batterymarch Park Quincy, Massachusetts 02169-7471 (800) 344-3555</td>
</tr>
<tr>
<td>3. 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 (615) 741-2123</td>
</tr>
<tr>
<td>4. ASHRAE standard 62.1-2013 Ventilation for Acceptable Indoor Air Quality</td>
<td>American Society of Heating, Refrigerating &amp; Air Conditioning Engineers 1791 Tullie Circle NE Atlanta, Georgia 30329 (404) 636-8400</td>
</tr>
<tr>
<td>5. 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 (615) 741-2981</td>
</tr>
</tbody>
</table>
### 6. 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.

### 7. 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 part 1191, 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.

### U.S. Department of Justice
Civil Rights Division, Disability Rights Section
NYA
950 Pennsylvania Ave, NW
Washington, DC 20530
(202) 514-4609

### TDEC Division of Water Pollution Control
Tennessee water quality control act of 1977 (TCA 69-3-101)

### Tennessee Department of Environment and Conservation Division of Water Pollution Control
401 Church Street
Nashville, TN 37243
(615) 532-0625
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 52 25
OWNER’S FIELD OFFICE

PART 1 - GENERAL:

1.01 This SECTION INCLUDES general requirements for the provision of temporary facilities to serve as the Owner's Field Office.

1.02 Provide facilities and services as required for performance of work and accommodation of personnel at site including Owner's and Designer's personnel. Discontinue and remove temporary support facilities, and make incidental similar use of permanent work of the project, only when and as authorized by Designer; and, if not otherwise indicated, immediately before time of substantial completion. Locate temporary support facilities for convenience of users, and for minimum interference with construction activities.

PART 2 - PRODUCTS:

2.01 OWNER’S FIELD OFFICE

A. Owner field office: Provide separate private office, equipped and furnished as stated below for use by the Owner’s Construction Representative.

1. Size: 160 SF minimum, with minimum dimension of 8'0”.
2. Windows: Minimum total area of 10% of floor area, with operable sash and insect screens.
3. Minimum four 110 volt duplex convenience outlets, one on each wall.
4. Furnishings
   a. One desk 54” x 30” with three drawers.
   b. One drafting table 36” x 72”, with one equipment drawer and chair.
   c. One metal, 2 drawer storage cabinet.
   d. Plan rack and sticks of sufficient number to hold contract drawings, shop drawings, and record drawings.
   e. One standard 4 drawer legal size metal file cabinet with lock and 2 keys.
   f. Twelve linear feet of bookcase.
   g. Three chairs.
   h. One tackboard 36” x 30”.
   i. One waste basket per desk and table.
5. Telephone on separate line.

B. Provide and pay for janitorial services for offices and periodic cleaning and maintenance for office and storage areas. Maintain approach walks free of mud, water, and/or snow.

2.02 SANITARY FACILITIES: Provide sanitary facilities at project site, separate for male and female personnel, adequate at all stages of Work, and of type acceptable to governing authorities.

PART 3 - EXECUTION: not used

END OF SECTION
PART 1 - GENERAL

1.01 JURISDICTION

This project is under the jurisdiction of the Tennessee Department of Environment and Conservation (TDEC) and a Storm Water Pollution Prevention Plan (SWPPP) has been filed. TDEC has provided a Construction General Permit (CGP) Notice of Coverage (CGP-NOC or just NOC). Under a NOC, the Owner is primary permittee, and the Contractor is considered a secondary permittee and may be referred to as a Construction Site Operator, by virtue of having day-to-day operational control of those activities at a project which are necessary to ensure compliance with a SWPPP for the site or other permit conditions.

1.02 RELATED SECTIONS

A. Copies of the NOC and SWPPP are normally included in the specifications but formatted without a specification section number. They may follow this Section or may be added by addendum or modification, and are to be considered a part of this Section. A copy of each, not bound into larger volumes of the Contract Documents, may be obtained from the Designer for ease of carrying out the requirements below.

B. Other technical aspects of the SWPPP are described in the Contract Documents where appropriate.

1.03 BASIC COORDINATION AND MONITORING

A. NOC: Post a copy of the NOC in a prominent, public location, such as a general notices board where building permit, employment regulations, and prevailing wage rates are posted. Protect the NOC from weather without obstructing its visibility. Repair or replace the NOC if it becomes damaged or missing.

B. SWPPP:

1. Maintain a copy of the SWPPP on site at all times. If a construction office/trailer is on site, keep the SWPPP documents inside it in a designated location. If there is no office/trailer, construct a SWPPP box and store the SWPPP documents therein. If the site is inactive, or does not have an on-site location adequate to store and protect the SWPPP, post a notice alongside the NOC telling where the SWPPP is stored, with a contact name and phone number. If the SWPPP is located off-site, provide reasonable local access to it during normal working hours.

2. Make updated plans and inspection reports available upon request to the operator of the local MS4, inspectors, and local agencies approving EPSC plans, grading plans, or storm water management plans.

C. RAINFALL MONITORING:

1. Maintain a rain gage on site, or determine a reliable local reference resource for rainfall monitoring. Some TBR campuses have such a resource. A resource off of the immediate campus where the project is located is not adequately local for normal daily readings. On days when Contractor's forces are not on site, if an on-campus local resource is unavailable, a rainfall reading can be obtained from a reliable nearby resource.

2. Take 24-hour rainfall depth measurement readings at a consistent time of day each day. When a rain event occurs, record the approximate beginning and ending time. Record the daily readings on the Weather Delay Report, Section 01 26 25, even if Work is not delayed.

3. Keep a copy of rainfall records with the SWPPP.
D. EPSC FIELD PLANS: A set of Erosion Prevention and Sediment Control (EPSC) plans shall be designated “field plans” and used to show modifications and updates and the date of each change, which can be hand-written on the sheets. Maintain these field plans nearby the overall project record documents.

E. SITE ASSESSMENT: As soon as SWPPP Site Assessment features are in place, notify the Designer that the Work is ready for the SWPPP Site Assessment.

F. TWICE-WEEKLY INSPECTIONS:

1. Conduct inspections of the storm water control measures twice-weekly and at least seventy-two (72) hours apart. Where sites or portion(s) of sites have been temporarily stabilized, or runoff is unlikely due to extreme drought, or winter conditions such as freezing or snow or ice covering, written notification may be submitted to the local environmental field office that inspections are being curtailed; and, if not objected to by that office, then such inspection may be conducted only once per month until construction activity resumes or thaw or precipitation results in runoff. Inspection requirements do not apply after Work has achieved final stabilization.

2. The person making the inspections must have active certification, having completed the TDEC “Fundamentals of Erosion Prevention and Sediment Control Level 1” course.

3. A “Construction Stormwater Inspection Certification (Twice-Weekly Inspections)” form must be filled out by the inspector for each inspection. Keep copies of completed forms with the SWPPP. Blanks of this form can be found in the Tennessee Erosion and Sediment Control Handbook, Fourth Edition, August 2012, appendix C, as issued by the Tennessee Department of Environment and Conservation.

G. FINAL STABILIZATION: Submit statement of final stabilization to the Designer when permanent site work is in place and temporary storm water control measures have been removed, typically when requesting substantial completion inspection, at the substantial completion inspection, or when requesting final inspection. Final stabilization is defined as seventy percent (70%) density of a permanent groundcover over all previously disturbed area(s).

H. RECORD DOCUMENTS: In addition to keeping the Project Record Documents complete with as-built conditions, at Final Stabilization assemble all twice-weekly inspection reports and site audit reports, and include these in the Project Data Binders.

PART 2 – PRODUCTS

PART 3 – EXECUTION

END OF SECTION
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
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
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
SECTION 01 78 25
DATA BINDER RECEIPT

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 88
## REPORT OF SUBCONTRACTORS AND SUPPLIERS

<table>
<thead>
<tr>
<th>Project</th>
<th>SBC Project Number</th>
<th>Page</th>
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</thead>
<tbody>
<tr>
<td>Fine Arts Classroom for East Tennessee State University</td>
<td>166/005-08-2013</td>
<td></td>
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</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, &quot;NO&quot;.</th>
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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:

<table>
<thead>
<tr>
<th>SBC Project Number:</th>
<th>166/005-08-2013</th>
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<tbody>
<tr>
<td>Institution/Location:</td>
<td>East Tennessee State University, Johnson City, TN</td>
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<tr>
<td>Project Name:</td>
<td>Fine Arts Classroom for East Tennessee State University</td>
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</tbody>
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<tr>
<th>Owner’s Facility Coordinator:</th>
<th>Phone:</th>
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<tr>
<td>Owner’s Maintenance Contact:</td>
<td>Phone:</td>
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<tr>
<td>Contractor Contact:</td>
<td>Phone:</td>
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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 a 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>
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<tbody>
<tr>
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<td>Accessibility</td>
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<td>Telecommunications</td>
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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):

<table>
<thead>
<tr>
<th>SBC Project Number:</th>
<th>166/005-085-2013</th>
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<tbody>
<tr>
<td>Institution/Location:</td>
<td>East Tennessee State University, Johnson City, TN</td>
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<tr>
<td>Project Name:</td>
<td>Fine Arts Classroom for East Tennessee State University</td>
</tr>
</tbody>
</table>

Subject Equipment / System:

<table>
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<th>Spec Reference</th>
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<tr>
<th>Trainer Name:</th>
<th>Company:</th>
<th>Phone:</th>
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<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:

<table>
<thead>
<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

1.01 Complete the processes of commissioning selected equipment and systems as specified. These should be listed in a companion section following this section. The absence of such a section does not negate the commissioning responsibilities. In the absence of such a section, review the specifications for commissioning requirements and provide a summary list as a submittal to the Designer for approval prior to performing the required commissioning.

1.02 SUBMITTALS

A. Functional Performance Testing:
Prepare and submit to the Designer Functional Performance Testing Procedures for approval of equipment and systems. Contractor will use forms provided in this section of the specifications. Testing procedures will be detailed step-by-step and specific to each system. The approved procedures will be used to conduct the Functional Performance Testing. Functional Performance Testing will be completed prior to Substantial Completion.

B. Commissioning Data:
Upon completion of the Functional Performance Testing, the Contractor will submit to the Designer the Commissioning section of the Operation and Maintenance Binder. The binder will be divided into sections. The binder will contain copies of the manufacturer’s installation and start-up procedures utilized by the installer and/or contractor, completed Functional Performance Testing Procedures and associated forms from Sections 23 08 xx and 26 08 xx, signed Functional Performance Test Certificates, and equipment and maintenance records for equipment and systems operated prior to Owner acceptance.

1.03 ROLES:

A. Designer, using its Consultants will:

1. Review and approve the contractors Functional Performance Testing Procedures.
2. Report on field observations and report deficiencies to the contractor.
3. Observe the contractors Functional Performance Testing.
5. Review final Commissioning Data.

B. Contractor:

1. Prepare and provide Functional Performance Testing Procedures for Designer approval.
2. Provide installation and start-up of all equipment and systems as prescribed by the manufacturer’s procedures.
3. Perform and maintain a maintenance and service log for equipment and systems that are being operated prior to Owner acceptance.
4. Provide manpower, supplies, testing instruments, etc. required to perform Functional Performance Testing.
6. Prepare three (3) sets of Commissioning Data for Designer review and approval.
1.04 SYSTEMS TO BE COMMISSIONED:

A. The following Mechanical systems and associated equipment are to be Commissioned as specified in Sections 23 08 xx.
   1. Mechanical (HVAC) Air and Water
   2. Associated Controls and Building Automation
   3. Domestic Hot Water

B. The following Electrical systems and associated equipment are to be Commissioned as specified in Sections 26 08 xx.
   1. Electrical panel boards.
   2. Power Circuits.
   3. Lighting levels.
   4. Generator and/or Back-up Power sources.

PART 2 – PRODUCTS: NOT USED

PART 3 – EXECUTION

3.01 Commissioning Construction Phase:
Complete the following Commissioning activities during the Construction Phase of the project. Submit for review and provide notification of activities.

A. Manufacturer’s system/equipment start-up procedures.

B. Specified manufacturer’s and/or independent testing agency reports.

C. Project schedule that included dates for start-up of equipment and systems, and Functional Performance Testing.

D. Minimum seven (7) day notification of code required testing and specified cleaning of systems.

E. Minimum seven (7) day notification of system and equipment start-up.

F. Control submittal on systems and equipment including drawings, sequences and programming.

G. Prepare detailed Functional Performance Testing Procedures for systems and equipment. Utilize the forms provided in this section of the specifications. Procedures will be detailed, step-by-step, and include description of expected results for verification. Modify test procedures as required by the Designers’ comments. Coordinate and schedule tests so that all parties involved will be present for final testing and acceptance.

H. Correct all deficiencies prior to final acceptance.

I. Prepare a list of all system and equipment warranties specified in the contract documents. Provide the warranty item and the contract document section number. Provide the Designer with an update list throughout the project.

J. Prepare a list of all deliverables specified in the contract documents. Provide the deliverable item and the contract document section number. Provide the Designer with an updated list throughout the project.
K. Prepare a list of all Training and Demonstrations specified in the contract documents. Provide the type of Training and/or Demonstration and the contract document section number. Provide the Designer with an updated list throughout the project.

L. Prepare a list of all tests, reports, services, etc. whether required by codes, independent authorities, or manufacturers as specified in the contract documents. Provide the type of test, report, services, etc. and the contract document section number. In the case that the test is required by state or local codes, update the list as soon as the information is available. Provide the Designer with an updated list throughout the project.

M. Systems and/or equipment will not be used for temporary purposes of any kind until authorized by the Designer in writing to ensure that required maintenance and warranties remain in force. The Contractor will be responsible for maintenance of all systems and equipment until final acceptance and will maintain on site a binder containing schedules of maintenance activities, items checked, repairs or replacements made and documents to verify that the work was performed. The documentation contained in this binder will become part of the Commissioning Binder.

3.02 Commissioning Acceptance Phase:
Complete the following Commissioning activities during the Acceptance Phase of the project. The activities described in this section must be completed prior to substantial completion.

A. Perform Functional Performance Tests of Mechanical and Electrical systems and equipment as specified utilizing the testing procedure prepared by the Contractor and approved by the Designer to verify proper calibration, operation and performance. The Contractor is responsible for providing all manpower, equipment and/or testing instruments required to perform tests. Functional Performance Testing will be performed in the presence of the Designer/Consultant and the Owner. Tests that fail to perform as required, will be retested upon correction. If retesting has to be rescheduled, the Contractor will be responsible for any additional charges.

B. All deliverables prescribed in the contract documents will be delivered to the Owner at the location designated by the Owner.

C. Perform all Training and Demonstrations prescribed in the contract documents.

D. Provide three (3) Final Commissioning Binders to the Designer for review and approval. Ensure that all forms are completely filled out and all testing results documented. If missing or incomplete information and/or data is identified by the Designer, reassemble replacement manuals with complete information prior to project final payment.

END OF SECTION
SECTION 01 91 23
PERFORMANCE TESTING IDENTIFICATION FORM

Owner's Project Number: 166/005-08-2013
Institution or Campus: East Tennessee State University
Building: Fine Arts Building for East Tennessee State University
Installer: 
Tests run by: 
System/Unit Identifier: 
Location: 

List Each Piece of Equipment Associated with This System and/or Unit by Tag #

<table>
<thead>
<tr>
<th>Piece of Equipment</th>
<th>Tag Number</th>
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<tbody>
<tr>
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## SECTION 01 91 26
PERFORMANCE TESTING PROCEDURES FORM

**Owner's Project Number:** 166/005-08-2013  
**Institution or Campus:** East Tennessee State University  
**Building:** Fine Arts Classroom for East Tennessee State University  
**Installer:**  

### System/Unit Identifier:

<table>
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<table>
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<tr>
<th>Step by Step Detailed Procedure</th>
<th>Expected Result</th>
<th>Observations</th>
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</tbody>
</table>

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**Performance Testing Procedures Form**

01 91 26 - 1

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Posted in XLS format

June 2011 OFD s019126
Page 1 of 1
**SECTION 01 91 29**

**FUNCTIONAL PERFORMANCE TEST CERTIFICATION**

<table>
<thead>
<tr>
<th>Owner's Project #:</th>
<th>166/005-08-2013</th>
<th>Project Name:</th>
<th>Fine Arts Building for East Tennessee State University</th>
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</thead>
<tbody>
<tr>
<td>Identification of Equipment or System:</td>
<td></td>
<td>Location of Equipment or System:</td>
<td></td>
</tr>
<tr>
<td>Manufacturer / Supplier:</td>
<td></td>
<td>Functional Performance Test Procedure No:</td>
<td></td>
</tr>
<tr>
<td>This date:</td>
<td></td>
<td>Components Included:</td>
<td></td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Signature</th>
<th>Print Name</th>
<th>Date</th>
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</thead>
<tbody>
<tr>
<td>Installer:</td>
<td>__________________________</td>
<td>__________________</td>
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<tr>
<td>General Contractor:</td>
<td>__________________________</td>
<td>__________________</td>
</tr>
<tr>
<td>Designer / Consultant:</td>
<td>__________________________</td>
<td>__________________</td>
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</tbody>
</table>
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Building demolition.
B. Selective demolition of built site elements.

1.02 RELATED REQUIREMENTS
A. Section 01.10.00 - Summary: Limitations on Contractor's use of site and premises.
B. Section 01.10.00 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
C. Site specific environmental documents.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. Site Plan: Showing:
   1. Areas for temporary construction and field offices.
B. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
   1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
   2. Identify demolition firm and submit qualifications.
   3. Include a summary of safety procedures.
C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

PART 2 PRODUCTS

2.01 MATERIALS
A. Fill Material: As specified in Section 31.23.23 - Fill.

PART 3 EXECUTION

3.01 SCOPE
A. Remove paving and curbs as required to accomplish new work.
B. Remove all other paving and curbs within site boundaries.
C. Within area of new construction, remove foundation walls and footings.
D. Outside area of new construction, remove foundation walls and footings.
E. Remove concrete slabs on grade within site boundaries.
F. Remove manholes and manhole covers, curb inlets and catch basins as indicated on the documents.
G. Remove lighting and poles.
H. Remove conduits identified to be removed.
I. Remove underground irrigation system.
J. Remove existing flag poles and turnover to Owner.
K. Remove other items indicated, for salvage, relocation, and recycling.
L. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Use of explosives is not permitted.
   3. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   4. Provide, erect, and maintain temporary barriers and security devices.
   5. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   6. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   7. Do not close or obstruct roadways or sidewalks without permit.
   8. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
   9. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.

D. Protect existing structures and other elements that are not to be removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

E. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

F. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

G. Perform demolition in a manner that maximizes salvage and recycling of materials.
   1. Dismantle existing construction and separate materials.
   2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

H. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.
D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7
days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at
least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of
utility type; protect from damage due to subsequent construction, using substantial barricades if
necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of
disconnected and abandoned utilities.

H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition
zone; identify and mark utilities to be subsequently reconnected, in same manner as other
utilities to remain.

3.04 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Remove from site all materials not to be reused on site; do not burn or bury.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 02.41.00
SECTION 03.10.00

CONCRETE FORMWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Form for all Cast-In-Place Concrete indicated on the drawings and subsequently remove all such forms except those earthforms described in this section.

B. Related Work Described Elsewhere:

1. Concrete Reinforcement: Section 03.20.00
2. Cast-In-Place Concrete: Section 03.30.00

1.02 QUALITY ASSURANCE

A. Qualifications of Workmen: Provide at least one person who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed, the referenced standards, and the requirements of this work, and who shall direct all work performed under this section.

B. Codes and Standards:

1. In addition to complying with all pertinent Codes and Regulations, comply with all pertinent recommendations contained in "Recommended Practice for Concrete Formwork". Publication ACI 347 of the American Concrete Institute.

2. Where provisions of pertinent codes and standards conflict with the requirements of this section of the specifications, the more stringent provisions shall govern.

1.03 PRODUCT HANDLING

A. Protection: Use all means necessary to protect formwork materials before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacement: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Designer and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 FORM MATERIALS

A. Form Lumber: All form lumber in contact with exposed concrete shall be new except as allowed for reuse of forms in Part 3 of this section of these specifications, and all form lumber shall be one of the following, a combination hereof, or an equal approved in advance by the Designer.


2. Douglas Fir-Larch or Southern Pine, Number Two Grade, seasoned, surfaced four sides.
2.02 TIES AND SPREADERS

A. Type: All form ties shall be a type which does not leave on open hole through the concrete and which permits neat and solid patching at every hole.

B. Design: When forms are removed, all metal shall not be less than 1" from the surface.

C. Wire Ties and Wood Spreaders: Do not use wire ties and wood spreaders.

2.03 ALTERNATE FORMING SYSTEMS

Alternate forming systems may be used subject to the advance approval of the Designer.

2.04 OTHER MATERIALS

All other materials, not specifically described but required for proper completion of concrete formwork, shall be as selected by the Contractor subject to the advance approval of the Designer.

PART 3 -EXECUTION

3.01 SURFACE CONDITIONS

A. Inspection:

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that forms may be constructed in accordance with all pertinent Codes and Regulations, and referenced Standards, and the original design.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Designer.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 CONSTRUCTION OF FORMS

A. General: Construction of all required forms to be substantial, sufficiently tight to prevent leakage of mortar, and able to withstand excessive deflection when filled with wet concrete.

B. Layout:

1. Form for all required Cast-In-Place Concrete to the shapes, sizes, lines, and dimensions indicated on the drawings.

2. Exercise particular care in the layout of forms to avoid necessity for cutting of concrete after it is in place.
3. Make proper provision for all openings, offsets, recesses, anchorage, blocking, and other features of the work as shown or required.

4. Perform all forming required for work of other trades and do all cutting and repairing of forms required to permit such installation.

5. Carefully examine the drawings and specifications and consult with other trades as required relative to provision for openings, reglets, chases, and other items in the form.

C. Embedded Items: Set all required steel frames, angles, grilles, bolts, inserts, and other such items required to be anchored in the concrete before the concrete is placed.

D. Bracing:
   1. Properly brace and tie the forms together so as to maintain position and shape and to insure safety to personnel.

   2. Construct all bracing, supporting members, and centering of ample size and strength to safely carry, without excessive deflection, all dead and live loads to which they may be subjected.

   3. Properly space the forms apart and securely tie them together, using metal spreader ties that give positive tying and accurate spreading.

E. Tolerance: Construct all forms straight, true, plumb, and square within a tolerance horizontally of 1 in 200 and a tolerance vertically 1 in 500.

F. Wetting: Keep forms sufficiently wetted to prevent joints opening up before concrete is placed.

3.03 PLYWOOD FORMS

A. Wood Forms: All footing forms shall be wood unless otherwise specifically approved by the Designer.

B. Earth Forms:
   1. Upon approval of the Designer, side forms for footings and tie beams may be of earth provided the soil will stand without caving in and the sides of the bank are made with a neat cut to the minimum dimensions indicated on the drawings.

   2. Make all necessary provisions to prevent cave-ins during placement of the concrete.

3.04 REUSE OF FORMS

A. General: Reuse of forms shall be subject to advance approval of the Designer.
B. Requirements:

1. Except as specifically approved in advance by the Designer, reuse of forms shall in no way delay or change the schedule for placement of concrete from the schedule obtainable if all forms were new.

2. Except as specifically approved in advance by the Designer, reuse of forms shall in no way impart less structural stability to the forms nor less acceptable appearance to finished concrete.

3.05 REMOVAL OF FORMS

A. General:

1. Side forms of footings may be removed seven days after placement of concrete, but the time may be extended if deemed necessary by the Designer.

2. Do not remove forms until the Designer approval has been obtained.

B. Removal:

1. Use all means necessary to protect workmen, passersby, the installed work and materials of other trades, and the complete safety of the structure.

2. Cut nails and tie wires or form ties off flush, and leave all surfaces smooth and clean.

3. Remove metal spreader ties on exposed concrete by removing or snapping off inside the wall surface and pointing up and rubbing resulting pockets to match the surrounding areas.

4. Flush all holes resulting from the use of spreader rods and sleeve nuts, using water, and then solidly pack throughout the wall thickness with cement grout applied under pressure by means of a grouting gun; grout shall be 1 part Portland Cement to 2-1/2 parts sand; apply grout immediately after removing forms.

END OF SECTION 03.10.00
SECTION 03.15.10
CORRUGATED STEEL FLOOR DECK

PART 1 - GENERAL

1.01 SCOPE

A. This section shall include all materials, equipment, and labor necessary for the installation of steel concrete form for floors over steel beams, joists, or walls in accordance with the specifications and drawings.

PART 2 - PRODUCTS

2.01 STEEL CONCRETE FORM

A. Steel concrete form shall be fabricated from high strength steel sheets conforming to ASTM A446 or ASTM A611 having a minimum yield strength of 80,000 psi. Galvanized steel shall have received a protective coating of zinc conforming to ASTM A525 and Federal Specifications QQ-S-775d, Type I.

2.02 DESIGN

A. Maximum fiber stress shall not exceed 30,000 psi under a total dead and live load of 150 psf. Deflection shall not exceed 1/240 of the span under a live load of 100 psf.

2.03 ACCESSORIES

A. Welding washers shall be furnished by steel form manufacturer.

2.04 ACCEPTABLE MANUFACTURERS

A. Consolidated Systems: Type ‘S’ 26 ga.
B. Vulcraft: Type 0.6C 26 ga.
C. New Millennium: Type 0.6FD 26 ga.

PART 3 - EXECUTION

3.01 FORM

A. Form shall be placed with the ribs perpendicular to the supports. End laps shall be a minimum of 2" inches and shall always occur over supports. All sheets shall be welded to the structural supports thru welding washers. Weld pattern shall be Pattern ‘B’ as recommended by Steel Deck Institute.

Concrete admixtures containing calcium chloride shall not be used over galvanized deck.

Deck shall be of sufficient length to bear on four (4) supports, (minimum of three (3) spans).

END OF SECTION 03.15.10
SECTION 03.20.00

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Furnish and install all reinforcement and associated items required and indicated on the drawings for all Cast-In-Place Concrete.

B. Related Work Described Elsewhere:

1. Placement of other Embedded Items: Section 03.10.00 & 03.30.00

2. Reinforcement in Concrete Unit Masonry: Section 04.22.00

1.02 QUALITY ASSURANCE

A. Qualifications of Workmen: Provide at least one person who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed and the best methods for their installation and who shall direct all work performed under this section.

B. Codes and Standards:

1. In addition to complying with all pertinent Codes and Regulations, comply with all pertinent recommendations contained in "Manual of Standard Practice for Detailing Reinforced Concrete Structures," publication ACI 315 Latest Edition of the American Concrete Institute and "Manual of Standard Practice" published by Concrete Reinforcing Steel Institute.

2. Where provisions of pertinent Codes and Standards conflict with this specification, the more stringent provisions shall govern.

1.03 SUBMITTALS

A. Shop Drawings:

1. Within 35 days after award of contract, and before any concrete reinforcement materials are delivered to the job site, submit shop drawings to the Designer in accordance with Section 01.30.00 of these specifications.

2. Do not deliver concrete reinforcement to the job site until receipt of shop drawings approval from the Designer.

3. Samples and Certificates: Provide all data and access required for testing as described in Section 01.40.00 of these specifications.
1.04 PRODUCT HANDLING

A. Protection:

1. Use all means necessary to protect concrete reinforcement before, during and after installation and to protect the installed work and materials of all other trades.

2. Store in a manner to prevent excessive rusting and fouling with dirt, grease, and other bond breaking coatings.

3. Use all necessary precautions to maintain identification after the bundles are broken.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Designer and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 CONCRETE REINFORCEMENT

All concrete reinforcement materials shall be new, free from rust, and complying with the following reference standards:

A. Bars for Reinforcement: "Specifications for Deformed Billet Steel Bars for Concrete Reinforcement," ASTM A615, Grade 60.


2.02 OTHER MATERIALS

A. All other materials not specifically described but required for a complete and proper installation of concrete reinforcement, shall be as selected by the Contractor subject to approval of the Designer.

B. Bar Supports:


2. Slabs, Beams, Walls & Columns: Bar supports as required to provide specified concrete covers.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Inspection:

1. Prior to installation of the work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
2. Verify that concrete reinforcement may be installed in strict accordance with all pertinent Codes and Regulations, the approved shop drawings, and the original design.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Designer.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 BENDING

A. General:

1. Fabricate all reinforcement in strict accordance with the approved shop drawings.

2. Do not use bars with kinks or bends not shown on the drawings or on the approved shop drawings.

3. Do not bend or straighten steel in a manner that will injure the material.

B. Design:

1. Bend all bars cold.

2. Make bends for stirrups and ties around a pin having a diameter not less than two times the minimum thickness of the bar. Provide minimum bend diameters as required by ACI 318.

3. Make bends for other bars, including hooks, around a pin having diameter not less than six times the minimum thickness of the bar for #8 and smaller and eight times the thickness of the bar for #9 and larger.

4. Any bars with visual signs of cracks due to bending will not be acceptable. Any dowels with cracks due to bending will be removed and replaced at no additional cost to Owner.

3.03 PLACING

A. General: Before the start of concrete placement, accurately place all concrete reinforcement, positively securing and supporting by concrete blocks, metal chairs or spacers, or by metal hangers.

B. Clearance:

1. Preserve clear space between bars of not less than one time the normal diameter or round bars.

2. In no case let the clear distance be less than 1" or less than one and one-third times the maximum size of aggregate.
3. Provide the following minimum concrete covering of reinforcing:
   a. Concrete Below Ground Deposited Against Forms: 2''.
   b. Concrete Deposited Against Earth: 3''.
   c. Concrete Elsewhere: As indicated on the drawings or otherwise approved by Designer.

C. Splicing:
   1. Horizontal Bars:
      a. Place bars in horizontal members with minimum laps at splices sufficient to develop the strength of the bars.
      b. Bars may be wired together at laps.
      c. Wherever possible, stagger the splices of adjacent bars.
      d. Splice 44 bar diameters minimum.
   2. Wire Fabric: Make all splices in wire fabric at least 1-1/2 meshes wide.
   3. Other Splices: Make only those other splices that are indicated on the approved shop drawings or specifically approved by the Designer.

D. Dowels: Place all required steel dowels and securely anchor them into position before the concrete is placed.

E. Obstructions: In the event conduits, piping, inserts, sleeves, or any other items interfere with placing reinforcement as indicated on the drawings or as otherwise required, immediately consult the Designer and obtain approval of new procedure before placing concrete. Cutting of rebar for conduit, piping, inserts is not permitted unless approved by the Designer.

3.04 CLEANING REINFORCEMENT

Steel reinforcement at the time concrete is placed around it, shall be free from rust scale, loose mil scale, oil, paint, and all other coatings which will destroy or reduce bond between steel and concrete.

END OF SECTION 03.20.00

100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
SECTION 03.30.00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Cast-In-Place Concrete required for this work is indicated on the drawings and includes, but is not necessarily limited to:

1. Concrete Curb; Sidewalks; Paving.
2. Slab on Grade, Footings, Tie Beams, Slab on Corrugated Deck.
3. Beams, Columns, Footings and Walls, Pedestals (Piers).
4. Testing Laboratory Services.

B. Related Work Described Elsewhere:

1. Concrete Formwork: Section 03.10.00
2. Concrete Reinforcement: Section 03.20.00

1.02 QUALITY ASSURANCE

A. Qualifications:

1. Provide at least one person who shall be present at all times during execution of this portion of the work and who shall be thoroughly trained and experienced in placing the types of concrete specified and who shall direct all work performed under this section.

2. For finishing of exposed surfaces of the concrete, use only thoroughly trained and experienced journeyman concrete finishers.

B. Codes and Standards:

1. In addition to complying with all pertinent Codes and Regulations, comply with all pertinent recommendations of "Structural Concrete for Buildings", publication ACI 301 Latest Edition of the American Concrete Institute and CRSI Manual of Standard Practice.

2. Where provisions of pertinent codes and standards conflict with this specification, the more stringent provisions shall govern.

1.03 SUBMITTALS

A. Materials List: Within 35 days after award of contract, and before any concrete is delivered to the job site, submit to the Designer in accordance with Section 01 30 00 of these specifications a complete list of all materials proposed to be furnished and installed under this portion of the work, showing manufacturer's name and catalog number of all items such as admixture and membrane, and the name and address of transit mix concrete supplier.
B. Transit Mix Delivery Slips:

1. Keep a record at the job site showing time and place of each pour of concrete, together with transit mix delivery slip certifying contents of the pour.

2. Make the record available to the Designer for inspection upon request.

3. Upon completion of this portion of the work, deliver the record and the delivery slips to the Designer.

1.04 PRODUCT HANDLING

A. Protection: Use all means necessary to protect Cast-In-Place Concrete materials before, during, and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Designer and at no additional cost to the Owner.

C. Prior to placement of concrete slabs, the stone base is to be covered to ensure no water is trapped in the drainage course. This is to be accomplished by covering the stone base after it is placed. This is to be accomplished by covering with plastic sheets and/or enclosing building prior to placement of stone drainage course.

D. Prior to placement of any concrete slabs coordinate with stain installer and stain material supplier to insure proper placement and protection of concrete is maintained.

PART 2 – PRODUCTS

2.01 CONCRETE

A. General:

1. All concrete, unless otherwise specifically permitted by the Designer, shall be transit mixed in accordance with ASTM C94.

2. The control of concrete production shall be under supervision of a recognized Testing Laboratory, selected by the Designer and paid for by the Contractor, who shall design the mixes and furnish inspection of batched aggregates and transit mixed concrete and testing of concrete according to Paragraph 3.09 of these specifications. The costs for developing a mix design are not part of the Testing Allowance. Costs for developing a mix design are to be included in the Contractor's Bid. The Contractor has the option of furnishing information according to Method 2 of Chapter 3, selection of proportions of ACI 301 Specification for Structural Concrete For Buildings, in lieu of Laboratory Mix Design.

B. Quality:

1. All concrete shall have the following minimum compressive strengths at 28 days and shall be proportioned within the following limits:
CAST IN PLACE CONCRETE
03.30.00 - 3

<table>
<thead>
<tr>
<th>Location of Concrete:</th>
<th>Min. psi at 28 Days</th>
<th>Max. Size Aggregate</th>
<th>Min. Sacks Cement (lbs.) per Cu. Yd.</th>
<th>Max. Slump in Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Footings, Grade Beams and Pedestals</td>
<td>3000</td>
<td>1&quot; (#57)</td>
<td>5.00 (470)</td>
<td>4 ± 1&quot;</td>
</tr>
<tr>
<td>Building Slab on Grade; Columns, Walls, Beams, Tie Beams, and Slabs Above Grade</td>
<td>4000</td>
<td>1&quot; (#57)</td>
<td>5.25 (494)</td>
<td>4±1&quot;</td>
</tr>
<tr>
<td>Exterior Slabs, Retaining Walls, Site Work – Air Entrained</td>
<td>4000</td>
<td>1&quot; (#57)</td>
<td>5.50 (517)</td>
<td>4 ± 1&quot;</td>
</tr>
</tbody>
</table>

2. Stone size may be changed to obtain a workable mix if concrete is to be placed by pumping.

3. Concrete that is subject to freezing temperatures while wet shall have a water cement ratio not exceeding six gallons per sack and shall contain 5-1/2% (± 1%) entrained air.

4. Slump shown in table above is without water reducing admixtures. Slump for concrete with water reducing admixtures may be in the range of 5" - 7", with no loss of strength. Concrete pours using pumping method for placement, are required to have adequate water reducing admixtures.

C. Cement: All cement shall be Portland Cement conforming to ASTM C150 Type I or II, and shall be the product of one manufacturer; the temperature of cement delivered to the plant shall not exceed 150° Degrees F.

D. Aggregates: All aggregates shall conform to ASTM C33 latest except as modified herein.
   1. Fine aggregate shall be mixed blend of manufactured and natural sand.

E. Water: All water shall be clean and free from deleterious matter.

F. Admixture: All concrete shall contain an approved water reducing admixture, equal to Master Builders "PolyHeed-N". Cement factor shall not be reduced. Air entrainment, Master Builders "Micro-Air" or approved equal.

G. **Fly Ash is NOT to be used in concrete slabs for this project.**

2.02 CHEMICAL SEALER AND CURING – *Only in Areas Approved by the Designer*

Immediately after slab finishing operations and surface water has completely disappeared, E-Cure spray applied concrete cure, hardener and dust proofer according to Manufacturer’s instructions.

Concrete Sealer: Only on areas designated on Finish Schedule. After concrete has cured for seven (7) days, apply two (2) coats of W.R. Meadows, Tiah Acrylic Concrete Sealer according to Manufacturer’s instructions.

Protect surface of slabs after the second coat has been installed.
2.03 MEMBRANES (WET CURING)

A. Burlap Cloth made from jute or kenaf and weighing approximately 305 grams per square meter (9 oz. per square yard) for moist curing shall conform to AASHTO M182 and shall use two layers.

B. Jointing Materials: All cement or tape used for sealing membrane joints shall be only as recommended by the manufacturer of the membrane being joined.

2.04 WATERSTOPS

A. Engineered Asphalt Waterstops:

1. Description: Preformed, asphalt, plastic, adhesive waterstop.


3. Approved material Vinylex Ultrastop.

B. Physical Properties:


2. Inert Material, AASHTO T111: 40.30 percent.

3. Volatile Matter, ASTM D6: 0.7 percent.


5. Ductility, ASTM D113: 5.1.

6. Softening Point, ASTM D36: Greater than 350º Degrees F.


8. Flash Point, ASTM D92: 619º Degrees F.


C. Primer: UltraStop Primer.

2.05 OTHER MATERIALS

All other materials not specifically described but required for a complete and proper installation of Cast-In-Place Concrete, shall be as selected by the Contractor subject to the approval of the Designer.

PART 3 – EXECUTION

3.01 SURFACE CONDITIONS

A. Inspection:
1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that all items to be embedded in concrete are in place.

3. Verify that concrete may be placed to the lines and elevations indicated on the drawings, with all required clearance from reinforcement.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Designer.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 PREPARATION

A. General:

1. Remove all wood scraps and debris from the areas in which concrete will be placed.

2. Thoroughly clean the areas to insure proper placement and bonding of concrete.

3. Thoroughly clean all transporting and handling equipment.

B. Notification: Notify the Designer at least 48 hours before placing concrete.

C. Waterstop:

1. Examine areas to receive engineered asphalt waterstops. Notify Designer of conditions that would adversely affect installation. Do not proceed with installation until unsatisfactory conditions are corrected.

2. Ensure concrete surfaces to receive engineered asphalt waterstops are clean, smooth, even, and free of dirt, dust, debris, oil, grease, and laitance.

   a. Install engineered asphalt waterstops in accordance with manufacturer's instructions.

   b. Install waterstops continuous, accurately in position and line, and at joints indicated on the drawings.

   c. Apply primer to clean concrete surfaces and allow to dry in accordance with manufacturer's instructions.

   d. Remove one side of protective backing on waterstops.

   e. Apply waterstops to primed concrete surfaces, pressing firmly along entire length.

   f. Joint strips of waterstop together with 1" inch to 2" inch overlap.
g. Remove remaining protective backing just before erecting forms as specified.

h. Protect installed waterstops from damage until completely encased in concrete.

3.03 PLACING CONCRETE

A. Method:

1. Convey concrete from mixer to place of final deposit by methods that will prevent separation and loss of materials.

2. For chuting, pumping, and pneumatically conveying concrete, use only equipment of such size and design as to insure a practically continuous flow of concrete at the delivery end without loss or separation of materials.

3. Deposit concrete as nearly as possible in its final position to avoid segregation due to rehandling and flowing.

4. Place concrete as dry as possible consistent with good workmanship, never exceeding the maximum specified slump, except for tolerance specified.

5. The use of garden rakes for placing and moving concrete will NOT be permitted on this project. Use a-come-along hoe for this purpose.

6. Place slabs on ground with pipe roller screed or use a vibrating screed. The Contractor must use either of the above methods for placing and compacting slabs on ground.

B. Rate of Placement:

1. Place concrete at such a rate that concrete is at all times plastic and flows readily between bare bars.

2. When placing is once started, carry it on as a continuous operation until placement of the panel or section is complete. Tie beams shall have construction joints at pile caps or intersection of tie beams. Construction joints to be approved by the Designer 48 hours prior to concrete placement.

3. Do not pour a greater area at one time than can be properly finished without checking; this is particularly important during hot or dry weather.

4. Do not, in any case, pour a slab length greater than 60’ feet without construction joints.

C. Consolidation:

1. Consolidate all concrete in accordance with provisions of ACI 309.

2. Consolidate each layer of concrete immediately after placing, by use of internal concrete vibrators supplemented by hand spading, rodding, or tamping. Do not use “jitter bug”, open grate type hand tamper unless approved by Designer.
3. Do not use vibrators to transport concrete inside the forms.

4. During all phases of operation, maintain a frequency of not less than 10,000 vibrations per minute per internal vibrator.

5. Do not vibrate forms or reinforcement.

6. Consolidation of slabs on ground shall be obtained with vibrating screeds, roller pipe screeds, internal vibrators, or other approved means.

D. Equipment:

1. Provide adequate number of units and power source at all times. Maintain spare units on hand to ensure adequacy.

2. If, in the opinion of the Designer, the equipment being used is not adequate to accomplish proper consolidation, the Designer may order delay in further placement of concrete until such equipment is available for use at the location of placement of concrete at no additional cost to the Owner.

E. Procedures:

1. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation of aggregates.

2. Insert the vibrator so as to penetrate the lift immediately below the one being placed, manipulate to blend the two lifts.

3. Do not insert the vibrator into lower courses which have begun to set.

4. Use the vibrator to melt down the concrete as it is being placed, and use the vibrator to consolidate the mass of concrete.

5. In the case of wall construction, assign at least one vibrator and vibrator operator to melting down the mix; and assign at least one other vibrator and vibrator operator to consolidating the mass of concrete.

6. Spacing between insertions of the vibrator which is used to consolidate shall not exceed twice the radius of action as shown in Table 5.1.4 of ACI 309.

7. Under no circumstances shall the points of insertion during the consolidation phase be more than 45 cm (18") apart.

F. Maintenance of Vibrators: Initiate a maintenance program for the vibrators to assure that they are operating at peak efficiency at all times, and to facilitate effective consolidation of the concrete.

G. Acceptability: Do not use retempered concrete or concrete that has been contaminated by foreign materials.

3.04 CONSTRUCTION JOINTS

A. Location: Make and locate construction joints so as not to impair the strength of the structure.
B. Approval: Obtain the Designer's approval of location of all construction joints and control joints in the work prior to start of concrete placement. Control joints to be a maximum of 15' on center.

3.05 LEVELING AND FINISHING

A. General:
1. Tamp slabs and then push float with a bull float as necessary.
2. Take care that the wet slab meets the screeds accurately and does not rise above or below them.
3. Carefully provide slab depressions as required for the finishes indicated on the drawings.

B. Finishing:
1. Unless otherwise indicated on the drawings, make all slabs even and uniform in appearance and, where no slope is required, level within plus or minus 1/8" in 10'.
2. Where floor drains or floor slopes are indicated, slope slabs uniformly to provide even fall for drainage.
3. Trowel all interior slabs to a smooth hard finish. Provide a non-slip finish in all areas subject to public traffic.
4. All exposed interior and exterior walls, beams, girders, underside of stairs, and columns to have a rubbed finish, fine sand texture surface.
5. Coordinate with stain supplier and installer for finish requirements in areas that receive acid stain.

3.06 HOT WEATHER REQUIREMENTS

A. Placement:
1. Do not use concrete with a placing temperature that will cause difficulty from loss of slump, flash set, or cold joints.
2. Maintain a concrete temperature during placement of less than 90° Degrees F.
3. Use all means necessary to avoid drying the concrete prior to finishing operations.

B. Protection: Provide and use all required windbreaks, sunshades, fog sprays, and other devices to protect the concrete.
3.07 CURING AND PROTECTION

A. General: Beginning immediately after placement, protect concrete from premature drying, hot or cold temperatures, and mechanical injury, and maintain with minimal moisture loss at relatively constant temperature for period necessary for hydration and hardening of concrete. Materials and methods of curing subject to approval. Coordinate with stain supplier and installer for curing and protection requirements in areas that receive acid stain.

B. Preservation of Moisture:

1. For concrete surfaces not in contact with forms apply one of following procedures immediately after completion of placement and finishing:
   
a. Application of absorptive mats or fabric kept continuously wet.
   
b. Application of sand kept continuously wet.
   
c. Continuous application of mist spray (not exceeding 150° Degrees F (66° Degrees C), during curing period.

C. Temperature, Wind and Humidity:

1. Cold Weather: When mean daily outdoor temperature is less than 40° Degrees F (7° Degrees C) maintain temperature of concrete between 50° and 70° Degrees F (10° and 21° Degrees C) for required curing period. When necessary make arrangements for heating, covering, insulating, or housing concrete work adequate to maintain required temperature without injury. Do not use combustion heaters during first 24 Hours unless precautions are taken to prevent exposure of concrete to exhaust gases which contain carbon dioxide.

2. Hot Weather: When necessary make provision for windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material. Take such protective measures as quickly as concrete hardening and finishing operations will allow.

3. Rate of Temperature Change: Keep changes in temperature of air immediately adjacent to concrete during and immediately following curing period as uniform as possible. Do not exceed 5° Degrees F (3° Degrees C) in any 1 Hour or 50° Degrees F (35° Degrees C) in any 24 Hour period.

D. Protection from Mechanical Injury: During curing period, protect concrete from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration. Protect all finishes concrete surfaces from damage by construction equipment, materials, or methods, and by rain or running water. Do not load self supporting structures in such a way as to over stress concrete.

E. Protection of Slabs on Grade from Frost: Interior slabs exposed to freezing temperatures shall be adequately protected so that frost does not develop in the supporting subgrade. This includes the use of blankets, heat or other appropriate methods. Slabs that heave due to frost and freezing shall be totally repaired or replaced to the Designer's satisfaction and approval.
3.08 DEFECTIVE WORK

A. Inspection:
   1. Immediately after curing membranes have been removed, inspect all concrete surfaces and patch all pour joints, voids, rock pockets, form tie holes, and other imperfections before the concrete is thoroughly dry.
   2. Do not patch until all concrete has been inspected by the Designer.

B. Patching:
   1. Minor Defective Areas:
      a. Chip away to a depth of about 1", leaving edges perpendicular to the surface; wet the area to be patched and a space of at least 6" wide around it to prevent water being absorbed out of the mortar.
      b. Coat the area to patched with a cement wash consisting of neat cement and a solution of one part "Flex-Con (Euclid)"; or equal approved by the Designer to four parts of water; apply the patching mortar immediately.
      c. Patching mortar shall consist of one part cement to three parts water, to a consistency as dry as possible within the requirements of handling and placing; thoroughly compact the mortar by ramming it into place.
      d. Screed off so as to leave the patch slightly higher than surrounding surfaces; leave undisturbed for a period of one to two hours to permit initial shrinkage, and then perform final finishing.
      e. Finish the patch to match adjacent surfaces and keep wet for at least seven days; provide and install all required protective covering.

2. Major Defective Areas: If the defects are serious or affect the strength of the structure, or if patching does not satisfactorily restore the quality and appearance of the surface, the Designer may require "cement gun concrete" to be used or the concrete to be removed and replaced complete in accordance with the provisions of this section, all at no additional cost to the Owner.

3.09 TESTS ON CONCRETE

A. Concrete: Provide for test purposes set of three cylinders each. Take one set for each 50 cubic yards or each days pour. At the request of the Designer additional test sets may be required.

B. Test one cylinder at seven days and the other two at 28 days. Make, cure, and test cylinders as per ASTM C39. Actual test result shall be average of the two 28 day cylinders. If strength falls below that specified, Designer shall require changes in proportions of mix to secure stronger concrete for remaining portions of job without extra cost to Owner. Reports of tests to be sent direct to Designer from testing lab.
The Contractor shall pay for all tests. These tests are NOT a part of Testing Allowance and should be included in the Contractor’s Bid.

C. Concrete Slump Tests: Make one test for every truck in accordance with standard method of slump test for consistency of Portland cement concrete, ASTM C143. Make one slump test for each set of cylinders to be submitted to laboratory.

D. ASTM C94 Specification requirements, that all concrete testing, slump and compressive test cylinders and preparation of samples shall be performed, prepared and tested by an individual that has demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the minimum guide lines for Certification of Concrete Field Testing Technicians, Grade I in accordance with ACI CP-2.

E. Personnel of laboratories accredited for testing freshly mixed field concrete under the National Voluntary Laboratory Accreditation Program (NVLAP) shall be considered equivalent to ACI Grade I.

F. Tests reports for concrete and grout shall show the location of concrete placement, number of cubic yards placed, addition of water and quantity (if any), temperature of concrete and atmosphere, slump, air content and compressive strength, and identity of person obtaining and making tests.

END OF SECTION 03.30.00
SECTION 03.35.43

DIAMOND POLISHING CONCRETE FLOORS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Products and procedures for coloring and diamond polishing concrete floors using multi-step wet/dry mechanical process, and accessories indicated, specified, or required to complete polishing.

1.02 DEFINITIONS

A. Terminology: As defined by Concrete Polishing Association of America (CPAA).

1.03 SUBMITTALS

A. Product Data: Manufacturer’s technical literature for each product indicated, specified, or required. Include manufacturer’s technical data, application instructions, and recommendations.

B. Installer Qualifications: Data for company, principal personnel, experience, and training specified in PART 1 “Quality Assurance” Article.

C. Field Quality Control – Static Coefficient of Friction Test Reports: Reports of testing specified in PART 3 “Field Quality Control” Article.

D. Maintenance Data: For inclusion in maintenance manual required by Division 01.

   1. Include manufacturer’s instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use.

   2. Include precautions against cleaning products and methods which may be detrimental to finishes and performance.

1.04 QUALITY ASSURANCE

A. Polisher Qualifications:

   1. Experience: Company experienced in performing specified work similar in design, products, and extent to scope of this Project; with a record of successful in-service performance; and with sufficient production capability, facilities, and personnel to produce specified work.

   2. Supervision: Maintain competent supervisor who is at Project during times specified work is in progress, and is currently certified as Craftsman or Master Craftsman by CPAA.

   3. Manufacturer Qualification: Approved by manufacturer to apply liquid applied products.
B. Walkway Auditor: Certified by NFSI to test polished floors for static coefficient of friction according to ANSI/NFSI B101.1.

C. Static Coefficient of Friction: Achieve not less than 0.5 for level floor surfaces as determined by quality control testing according to ANSI/NFSI B101.1.

D. Field Mock-Up for Aesthetic Purposes: Before performing work of this Section, provide as many field mock-ups required to verify selections made under submittals and to demonstrate aesthetic effects of polishing. Approval does not constitute approval of deviations from Contract Documents, unless such deviations are specifically approved by Designer in writing.

1. Grind, hone, and polish 12’ square floor area for each finish or color approved under sample submittals; include edges and joints.

2. Use same personnel, including supervisors, which will perform work.

3. Install products and materials according to specified requirements.

4. Work shall be representative of those to be expected for work.

5. Finish various components to show maximum variation that will exist in work.

6. Approval is for following aesthetic qualities:

   a. Compliance with approved submittals.
   b. Uniformity of exposed aggregate.
   c. Uniformity of sheen.
   d. Uniformity of color. Designer shall select color from full range of manufacturer’s color chart.

7. Obtain Designer’s approval before starting work on Project.

8. Protect approved field mock ups from elements with weather resistant covering.

9. Maintain field mock ups during construction in an undisturbed condition as a standard for judging completed work.

10. Do not demolish, alter, or remove field mock ups until acceptable to Owner and Designer.

E. Pre-Installation of Concrete Conference: Prior to placing concrete for areas scheduled for polishing, conduct conference at Project to comply with requirements of applicable Division 01 Sections.

1. Required Attendees:

   a. Owner.
   b. Designer.
   c. Contractor, including Supervisor.
   d. Concrete Producer.
   e. Concrete Finisher, including Supervisor.
   f. Concrete Polisher, including Supervisor.
   g. Technical Representative of Liquid Applied Product Manufacturers.
   h. Walkway Auditor.

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2. Minimum Agenda: Polisher shall demonstrate understanding of work required by reviewing and discussing procedures for, but not limited to, following:
   a. Tour mock-up and representative areas of required work, discuss and evaluate for compliance with Contract Documents, including substrate conditions, surface preparations, sequence of procedures, and other preparatory work performed by other installers.
   c. Review Approved Submittals.
   d. Review Procedures, including, but not limited to:
      1. Details of each step of grinding, honing, and polished operations.
      3. Protecting concrete floor surfaces until polishing work begins.
      4. Protecting polished concrete floors after polishing work is completed.

3. Reports: Record discussions, including decisions and agreements reached, and furnish copy of record to each party attending.

1.05 FIELD CONDITIONS

A. Damage and Stain Prevention: Take precautions to prevent damage and staining of concrete surfaces to be polished.
   1. Prohibit vehicle parking over concrete surfaces to be polished.
   2. Prohibit pipe cutting operations over concrete surfaces to be polished.
   3. Prohibit storage of any items over concrete surfaces to be polished for not less than 28 days after concrete placement.
   4. Prohibit ferrous metals storage over concrete surfaces to be polished.
   5. Protect from petroleum, oil, hydraulic fluid, or other liquid dripping from equipment working over concrete surfaces to be polished.
   6. Protect from acids and acidic detergents contacting concrete surfaces to be polished.
   7. Protect from painting activities over concrete surfaces to be polished.

B. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting liquid applied product application.
PART 2 – PRODUCTS

2.01 LIQUID APPLIED PRODUCTS

A. Liquid Densifier: Odorless, non-hazardous, silicate that penetrates concrete react with free lime and calcium hydroxide to produce permanent chemical reaction that hardens and densifies concrete surface.

B. Dyes: Extremely fine molecules of color solvent or dye for mixing with water or acetone that is designed to penetrate and color concrete surface.

C. Pigmented Microstains: Extremely fine pigment particles in a water based silicate solution that penetrates concrete and reacts with calcium hydroxide to lock in color particles.

D. Polish Guard: Non-film, stain resistant, food resistant, chemical stain resistant, impregnating sealant designed to be used on concrete surfaces previously densified.

2.02 ACCESSORIES

A. Patching Compound: Compound composed of 40 percent Portland cement, 45 percent limestone, and 15 percent vinyl acetate copolymer, when mixed with dust salvaged from grinding process forms a paste that hardens when surface imperfections are filled.

B. Grout Material: Clear modified silicate sealant, containing no pore clogging latex, when mixed with dust salvaged from grinding process forms a paste that reacts with calcium hydroxide in concrete that hardens when surface imperfections are filled.

C. Protective Cover: Non-woven, puncture and tear resistant, polypropylene fibers laminated with a multiply, textured membrane, not less than 18 mils in thickness.

2.03 POLISHING EQUIPMENT

A. Field Grinding and Polishing Equipment:
   1. Variable speed, multiple head, counter rotating, walk behind machine with not less than 600 pounds of down pressure on grinding or diamond polishing pads.
   2. If dry grinding, honing, or polishing, use dust extraction equipment with flow rate suitable for dust generated, with squeegee attachments.

B. Edge Grinding and Polishing Equipment: Hand held or walk behind machines which produces same results, without noticeable differences, as field grinding and polishing equipment.

C. Burnishing Equipment: High speed walk behind or ride on machines capable of generating 1000 to 2000 revolutions per minute and with sufficient head pressure of not less than 20 pounds to raise floor temperature by 20° degrees F.

D. Metal Bonded Pads: Grinding pads with embedded industrial grade diamonds of varying grits fabricated for mounting on equipment.

E. Resin Bonded Pads: Polishing pads with embedded industrial grade diamonds of varying grits fabricated for mounting on equipment.

F. Burnishing Pads: Maintenance pads for use with high speed burnishing equipment.

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PART 3 – EXECUTION

3.01 EXAMINATION

A. Acceptance of Surfaces and Conditions:
   1. Examine substrates to be polished for compliance with requirements and other conditions affecting performance.
   2. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents.
   3. Starting work within a particular area will be construed as acceptance of surface conditions.

3.02 PREPARATION

A. Cleaning New Concrete Surfaces:
   1. Prepare and clean concrete surfaces.
   2. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, paint splatter, and other contaminants incompatible with liquid applied products and polishing.

3.03 VAPOR TESTING CONCRETE FLOORING

A. Alkalinity:
   1. Test Method: Measure pH according to method indicated in ASTM F 710.

B. Moisture Vapor Transmission Rate:
   1. Test Method: Perform anhydrous calcium chloride test according to ASTM F 1869.
   2. Acceptable Results: Not more than five (5) pounds per 1000 square feet in 24 hours.

C. Relative Humidity:
   2. Acceptable Results: Not more than 75 percent.

3.04 COLORING CONCRETE FLOORS

A. Dye or Pigmented Microstain Application:
   1. Apply solution by methods and techniques required by manufacturer to produce finish matching approved mock-ups.
2. Maintain wet edge, working newly applied solution into edges of adjacent wet edges of previously treated surfaces.

3. Maintain consistent saturation throughout application.

4. Avoid splashing, dripping, or puddling of solution on adjacent substrates.

5. When color matches approved mock-ups, neutralize as required by manufacturer.

3.05 POLISHING CONCRETE FLOORS

A. Sequence of Polishing: Perform polishing before partition studs are erected.

B. Initial Grinding:
   1. Use grinding equipment with metal bonded grinding pads.
   2. Begin grinding in one direction using sufficient size grit pad.
   3. Make sequential passes with each pass perpendicular to previous pass using finer grit pad with each pass, up to 150 grit.
   4. Achieve maximum refinement with each pass before proceeding to finer grit pads.
   5. Vacuum floor using squeegee vacuum attachment after each pass.
   6. Continue grinding until aggregate exposure matches approved field mock-ups.

C. Treating Surface Imperfections:
   1. Mix patching compound and grout material with dust created by grinding operations to match color of adjacent concrete surface.
   2. Fill surface imperfections including, but not limited to, holes, surface damage, small and micro cracks, air holes, pop-outs, and voids.
   3. Work compound and treatment until color differences between concrete surface and filled surface imperfections are not reasonably noticeable when viewed from 10 feet away under lighting conditions that will be present after construction.

D. Liquid Densifier Application: Apply undiluted to point of rejection, remove excess liquid, and allow to cure according to manufacturer's instructions.

E. Grout Grinding:
   1. Use grinding equipment and appropriate grit grinding pads.
   2. While applying fresh grout material prior to, grind concrete in direction perpendicular to initial grinding to remove scratches.
   3. Vacuum floor using squeegee vacuum attachment after each pass.
F. Honing:
   1. Use grinding equipment with resin bonded grinding pads.
   2. Grind concrete in one direction starting with 50 grit pad and made as many sequential passes required to remove scratches, each pass perpendicular to previous pass, up to 400 grit pad reaching maximum refinement with each pass before proceeding to finer grit pads.
   3. Auto scrub or vacuum floor using squeegee vacuum attachment after each pass.

G. Polishing:
   1. Use polishing equipment with resin bonded polishing and burnishing pads.
   2. Begin polishing in one direction starting with 800 grit pad.
   3. Make sequential passes with each pass perpendicular to previous pass using finer grit pad with each pass, up to 3000 grit.
   4. Achieve maximum refinement with each pass before proceeding to finer grit pads.
   5. Auto scrub or vacuum floor using squeegee vacuum attachment after each pass.
   6. Continue polishing until gloss appearance, as measured according to ASTM E 430, matches approved mock ups.

H. Polish Guard: Uniformly apply and remove excessive liquid according to manufacturer’s instructions.

I. Final Polish: Using burnishing equipment and finest grit burnishing pads, burnish to uniform sheen matching approved mock-up.

J. Final Polished Concrete Finish:
   1. Class B – Fine Aggregate (Salt and Pepper) Finish: Remove not more than 1/16” inch of concrete surface by grinding and polishing resulting in majority of exposure displaying fine aggregate with no, or small amount of, medium aggregate at random locations.
   2. Level 2 – Medium Gloss Appearance:
      a. Procedure: Not less than five (5) step process with full refinement of each diamond pad up to 800 grit resin bonded pad with one application of densifier.
      b. Gloss Reading: Not less than 55 according to ASTM E 430 before polish guard application.

3.06 FIELD QUALITY CONTROL
   A. Field Testing: Engage a qualified walkway auditor to perform field testing according to ANSI/NFSI B101.1 to determine if polished concrete floor finish complies with specified static coefficient of friction.
3.07 CLOSEOUT ACTIVITIES

A. Maintenance Training: CPAA Master Craftsman shall train Owner’s designated personnel in proper procedures for maintaining polished concrete floor.

3.08 PROTECTION

A. Covering: After completion of polishing, protect polished floors from subsequent construction activities with protective covering.

END OF SECTION 03.35.43
SECTION 03.40.00

PRECAST CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Comply with Prestressed Concrete Institute (PCI) Manual MNL 117 “Manual for Quality Control for Plants and Products for Architectural Precast Concrete Products”.

B. Plates and angles cast into panels shall be A36 steel. Inserts, bolts, and other accessories shall be protectively coated. Precast units shall be secured to structure by welding and bolting as indicated. All welded joints and exposed or accessible steel clips, bolts, and other connecting devices shall be stainless steel.

C. Provide precast concrete decorative exterior trim pieces at window heads, sills and at all locations indicated on the drawings. Precast trim pieces shall have a sandblasted finish. Support system to be by Halfen Anchoring Systems.

D. Quality Assurance: Comply with applicable provisions of:

   PCI Design Handbook – MNL – 120-04,
   PCI Connections Manual – MNL – 123-88,
   PCI Seismic Design of Precast/Prestressed Concrete Structures – MNL – 140-07,
   PCI Tolerance Manual – MNL – 135 – 00 and
   ACI 318 Building Code and Commentary.

E. Submittals of all precast material shall be supplied to the Designer, a minimum of 30 days prior to start of fabrication.

END OF SECTION 03.40.00
PART 1 GENERAL

1.01 RELATED REQUIREMENTS
A. Section 03.30.00 - Cast-in-Place Concrete: Admixtures.
B. Section 07.62.00 - Sheet Metal Flashing and Trim: Reglets recessed in units.

1.02 REFERENCE STANDARDS
A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.
J. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.
N. IAS AC157 - Accreditation Criteria for Fabricator Inspection Programs for Reinforced and Precast/Prestressed Concrete; 2010.

1.03 ADMINISTRATIVE REQUIREMENTS
A. Preinstallation Meeting: Convene one week prior to commencing work of this section.

1.04 SUBMITTALS
A. Product Data: Manufacturer's information on accessory products, including pigments, admixtures, inserts, plates, etc.
B. Shop Drawings: Indicate layout, unit locations, configuration, unit identification marks, reinforcement, integral insulation, insulated panel system connectors, connection details, support items, location of lifting devices, dimensions, openings, and relationship to adjacent materials. Provide erection drawings.
   1. Include details of mix designs.
   2. Include structural design calculations.
C. Integrally Insulated Panel System Manufacturer's Qualification Statement.
D. Fabricator's Qualification Statement: Provide documentation showing precast concrete fabricator is accredited under IAS AC157.
E. Fabricator Qualification Statement: __________.
F. Sustainable Design Reporting: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete, mix design(s) used showing the quantity of Portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used; use Material Content Form.
G. Maintenance Data: Indicate surface cleaning instructions.

1.05 QUALITY ASSURANCE
   A. Design Engineer Qualifications: Design precast concrete units under direct supervision of a Professional Structural Engineer experienced in design of precast concrete and licensed in Tennessee.
   B. Fabricator Qualifications:
      1. Firm having at least 2 years of documented experience in production of precast concrete of the type required.
      2. Plant certified under Precast/Prestressed Concrete Institute Plant Certification Program; product group and category A1 - Architectural Precast Concrete.
   C. Welder Qualifications: Qualified within previous 12 months in accordance with AWS D1.1/D1.1M and AWS D1.4/D1.4M.
   D. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.06 MOCK-UP
   A. Include mock-up panel with typical window.

1.07 DELIVERY, STORAGE, AND HANDLING
   A. Handling: Lift and support precast units only from support points.
   B. Blocking and Lateral Support During Transport and Storage: Use materials that are clean, non-staining, and non-harmful to exposed surfaces. Provide temporary lateral support to prevent bowing and warping.
   C. Protect units to prevent staining, chipping, or spalling of concrete.
   D. Mark units with date of production in location that will be concealed after installation.

PART 2 PRODUCTS

2.01 PRECAST UNITS
   A. Precast Architectural Concrete Units: Comply with PCI MNL-120, PCI MNL-122, PCI MNL-123, PCI MNL-135, and ACI 318.
1. Design Loads: Static loads, anticipated dynamic loading, including positive and negative wind loads, thermal movement loads, and erection forces as defined by applicable code.
2. Calculate structural properties of units in accordance with ACI 318.
3. Accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
4. Provide connections that accommodate building movement and thermal movement and adjust to misalignment of structure without unit distortion or damage.

B. Finish Type A: Ensure exposed-to-view finish surfaces of precast units are uniform in color and appearance.

2.02 REINFORCEMENT
A. Comply with requirements of Section 03.20.00.

2.03 CONCRETE MATERIALS
A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
B. Other Cementitious Materials:
   1. Fly Ash or Natural Pozzolans: Comply with ASTM C618.
C. Fine and Coarse Structural Aggregates: ASTM C33/C33M.
D. Lightweight Structural Aggregate: ASTM C330/C330M.
E. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with ASTM C979/C979M.
F. Water: Clean and not detrimental to concrete.
G. Admixtures: Air entrainment as specified in Section 03.30.00.

2.04 FORM LINERS
A. Material: Glass fiber reinforced polyester, Acrylonitrile butadiene styrene, Polyvinyl chloride, Polystyrene, or Polyurethane.

2.05 SUPPORT DEVICES
A. Connecting and Support Devices; Anchors and Inserts: ASTM A36/A36M steel; hot-dip galvanized in accordance with ASTM A153/A153M.
   1. Clean surfaces of rust, scale, grease, and foreign matter.

2.06 ACCESSORIES
A. Bearing Pads: High density plastic; Shore A Durometer ____; 1/8 inch thick, smooth both sides.
B. Reglets: Specified in Section 07.62.00.

2.07 FABRICATION
A. Fabricate in conformance with PCI MNL-117 and PCI MNL-135.
B. Use form liners in accordance with manufacturer's instructions.
C. Place thin brick in form liner in accordance with manufacturer's instructions. Mix bricks from several cartons for uniform distribution of color variations.
D. Place recessed flashing reglets continuous and straight.
E. Locate hoisting devices to permit removal after erection.
F. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.

G. Minor patching in plant is acceptable, providing structural adequacy and appearance of units is not impaired.

2.08 FABRICATION TOLERANCES

A. Conform to PCI MNL-117 and PCI MNL-135, except as specifically amended below.
   1. Maximum Variation From Nominal Face Dimensions: Plus or minus 3/32 in.
   2. Maximum Variation From Square or Designated Skew: Plus or minus 1/8 inch in 10 feet.
   3. Maximum Variation from Thickness: Plus or minus 1/8 in.
   5. Maximum Bowing of Members: Plus or minus length/360.

2.09 SOURCE QUALITY CONTROL

A. Provide testing and analysis of concrete mix.

B. Take one air entrainment test cylinders for each set of exterior concrete test cylinders taken.

C. Take water absorption test in accordance with PCI MNL-117.

PART 3 EXECUTION - NOT USED

END OF SECTION 03.45.00
SECTION 03.60.00

NON SHRINK GROUT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provide a non-shrink, non-metallic grout that complies with Corps of Engineers Specification CRD-C-621. Grout shall have a minimum compressive strength of 5000 psi at 28 days.

END OF SECTION 03.60.00
PART 1 – GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Masonry Accessories: Section 04.16.00

B. Unit Masonry: Section 04.22.00

1.02 QUALITY ASSURANCE

A. Standards:

   a. ASTM C5-68, Quicklime for Structural Purposes.
   b. ASTM C91, Masonry Cement.
   c. ASTM C144, Aggregate for Masonry Mortar.
   d. ASTM C150, Portland Cement.
   e. ASTM C207, Hydrated Lime for Masonry Purposes.
   f. ASTM C270, Mortar for Unit Masonry.
   g. ASTM C387, Packaged, Dry, Combined Materials for Mortar and Concrete.
   h. ASTM C476, Mortar and Grout for Reinforced Masonry.
   i. ASTM C595, Blended Hydraulic Cements.

2. Brick Institute of America.

   a. Field Tests for Grout and Mortar.

B. Use same Manufacturer's products throughout project.


1.03 SUBMITTALS

A. Samples: Two cubes of hardened mortar, approximately 2” inches (51 mm), for color selection and matching.

B. Reports of quality control tests.
C. Manufacturer's Certification that materials meet specification requirements.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING
A. Deliver and store manufactured products in original unopened containers.
B. Store cementitious ingredients in weather tight enclosures and protect against contamination and warehouse set.
C. Stock pile and handle aggregates to prevent contamination from foreign materials.
D. Store admixtures to prevent contamination or damage from excessive temperature changes.
E. Keep water free of harmful materials.

1.05 ENVIRONMENTAL REQUIREMENTS
A. Heat mixing water when air temperature is below 40° Degrees F (4° C) and heat aggregates when air temperature is below 32° Degrees F (0° C), to assure mortar temperatures between 40° Degrees F (4° C) and 120° Degrees F (50° C) until used.
B. Produce subsequent mortar batches within ±10° Degrees F (±6° C) of first batch.
C. Do not heat water or sand above 120° Degrees F (50° C).

PART 2 – PRODUCTS

2.01 MORTAR
A. ASTM C270, Specifications, Type S.
B. Cultured Stone Units “ONLY”: ASTM C270, Type N.
C. Maximum air content 12%.
D. Aggregate: ASTM C144, Except for joints less than 1/4" (6mm), use aggregate graded with 100% passing the No. 16 sieve.
E. Water: Clean and free of deleterious amounts of acids, alkalies, or organic materials.
F. Mortar to be Colored or Natural Gray. Contractor to use $18.00/Bag for colored mortar pricing. Final selection of colored mortar shall be approved and selected by the Designer.
G. Mixes:
   1. Mix mortar materials to produce mortar cubes having 1800 psi compressive strength when tested in accordance with compressive strength test, ASTM C270. Minimum water retention, 75%, maximum air content, 18%.
   2. Proportions: Determine by laboratory design mixes to produce a compressive strength of 1800 psi.
3. Mixing Procedures:
   a. Measure materials by volume or equivalent weight.
   b. Do not measure by shovel.
   c. Mix ingredients in clean mechanical batch for 3-5 minutes.
   d. Use maximum amount of water to produce workable consistency.
   e. Retemper stiffened mortar only within 2-1/2 hours after initial mixing.

H. All walls to extend tight to metal deck. Where there are cracks, voids or open joints fill with mortar, grout or fire caulking.

2.02 GROUT

A. Grout Mixes:
   1. Grout: ASTM C476, Coarse grout having 2,500 minimum psi strength at 28 days.
   2. Grout Mixing:
      a. Control batching procedure to ensure proper volume proportions of grout materials and achieve grout slump between 8” and 10” inches.
      b. Mix grout in accordance with ASTM C94.
      c. Measure grout materials mixed at job site by volume and mix all ingredients in Mechanical Mixer for minimum of five minutes.

PART 3 – EXECUTION

3.01 APPLY MORTAR IN ACCORDANCE WITH SECTION 04220.

3.02 FIELD QUALITY CONTROL

A. Field Compressive Test Specimen For Mortar: ASTM C270. Make and test one compressive test specimen for each 5,000 square feet of wall.

B. Field Compressive Test Specimen For Grout: ASTM C1019-89a. Make and test one compressive test specimen for each 5,000 square feet of wall.

C. Refer to Specification Section 03.30.00, Cast-in-Place Concrete, Paragraph 3.09.

D. The Contractor shall pay for all tests. These tests are NOT a part of Testing Allowance and should be included in the Contractor’s Bid.

END OF SECTION 04.11.00
SECTION 04.16.00
MASONRY ACCESSORIES

PART 1 – GENERAL

1.01 DESCRIPTION
A. Work Included: The extent of the masonry work is shown on the drawings.

B. Related Work Described Elsewhere:
   1. Unit Masonry: Section 04.22.00

1.02 SUBMITTALS
A. Manufacturer's Data: Submit manufacturer's specifications and installation instructions for each masonry accessory required. Include data substantiating that materials comply with specified requirements. Send a copy of manufacturer's instructions to the installer.

PART 2 – PRODUCTS

2.01 GENERAL
A. Fire Rated Masonry: Wherever a Fire Resistance Classification is shown or scheduled for unit masonry construction (1-Hour, 2-Hour and similar designation), provide accessories which have been tested and listed for the construction shown.

2.02 REINFORCEMENT
A. Continuous Wire Reinforcing and Ties for Masonry:
   1. General: Provide welded wire units prefabricated in straight lengths of not less than 10' feet (3m) with matching corner and tee units. Fabricate from cold drawn steel wire complying with ASTM A82, with deformed continuous side rods and plain cross rods and a unit width of 1-1/2" to 2" (38mm to 51mm) less than thickness of wall or partition. Corner and tee units to be provided at all wall intersections.

B. For Single Wythe Masonry Provide Units Fabricated As Follows:
   1. Truss type fabricated with single pair of side rods and continuous diagonal cross rods.

C. Wire Size: Fabricate with 9 gauge side and cross rods, unless otherwise shown or specified. Refer Paragraph E. below:
   1. For use in interior partition walls fabricate from mill galvanized wire.
   2. For use in exterior walls fabricate from hot dipped galvanized wire with 1.5 oz. zinc coating complying with ASTM A153, Class B-2.
D. Manufacturers: The following manufacturers offer products which comply with the requirements of this specification:

1. Wire-Bond.
2. Dur-O-Wal.
3. Hohmann and Barnard.
4. Lox-All, Cumberland Corporation.
5. Southern Wire Mesh Company.

E. For exterior walls with block back up and brick veneer provide masonry reinforcing as follows: "Tab-Tie" prefabricated continuous reinforcing spaced as shown on drawings; Durowal "Dur-O-Tab" or equal. Side wires 3/16" diameter deformed and all galvanized. Refer to drawings for different wall thickness.

F. Bending of "Tabs" will not be permitted for any reason.

2.03 ANCHORING DEVICES FOR MASONRY

A. General: Provide straps, bars, bolts and rods of the type and size shown, but fabricated from not less than 16 gauge sheet metal or 3/8" (9mm) diameter rod stock, unless otherwise shown.

B. Stud Ties: Durowal (or equal), Model No. DA210 with "Tri-Tie" triangular 3/16" diameter anchor. Space 16" o.c. each way.

C. Brick Ties to Exterior Wall Metal Studs: AA Wire Products Company (or equal), model AA 400 triangular tie with AA 401C screw on anchor strap; 1/4" diameter wire X 7/8" X 12" gauge strap, all Type 304 stainless steel.

1. Metal brick tie straps shall be anchored by stainless steel screws, through sheathing material and firmly into metal exterior wall stud. Do not anchor to sheathing alone. Maximum anchorage at 24" X 16" o.c.

D. Column Ties: "Durowal" (or equal), Model No's. D/A 709-711 or 710; triangular anchors 1/4" diameter; trapezoidal ties D/A 750 and D/A 730; rectangular ties D/A 511, 1/4" diameter. Spacings as per manufacturers recommendations and maximum of 16" o.c. vertically.

E. Debonded Shear Anchors: Equal to "Durowal" DA 2200, joint stabilizing anchor. Standard Type, allowable load transfer capacity of 305 pounds per anchor, maximum vertical spacing of 8" inches.

2.04 FLASHING FOR MASONRY

A. General: Provide concealed flashings shown to be built into masonry.

1. 5 oz. copper deformed for mechanical keying to mortar.
2. 5 oz. copper with glass fiber facing laminated to both sides.
B. Manufacturers Offering Products to Comply with the Requirements include the Following:

1. York.
2. Polytite.
3. Cheney.
4. Sandou.
5. Advanced.

2.05 MISCELLANEOUS MASONRY ACCESSORIES

A. Reinforcing Bars: Deformed steel reinforcing bars complying with ASTM A615 Grade 60 of the sizes shown.

B. Preformed Control Joint: Factory-extruded solid section of rubber conforming to ASTM C2000 2AA 805 with a durometer hardness of approximately 80 when tested in conformance with ASTM D2240.

1. Control joint section shall be capable of resisting a uniform load of 294 lb. per foot for wide flange section and 338 lb. per foot for regular section.

C. Control Joint in Face Veneer: 3/8" thick X 3" wide, closed cell neoprene material conforming to ASTM D1056, class RE41, compression up to 35%, manufactured with an adhesive surface.

1. Manufacturers Offering Products to Comply with the Requirements Include The Following:
   a. AA Wire Products Company.
   b. Dur-O-Wal.
   c. Ty-Wal.

D. Grout Stop: "Durowal" D/A 1010-1013, Fil Stop fiber glass mesh, 10 x 10 white resin coated glass mesh, conforming to ASTM D1668, Type 207.

PART 3 – EXECUTION

3.01 INSPECTION

A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 COORDINATION

A. Carefully coordinate with all other trades to ensure proper and adequate interface of the work of other trades with the work of this section.

END OF SECTION 04.16.00

100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
SECTION 04.22.00

UNIT MASONRY

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Concrete unit masonry, split face concrete unit masonry, face brick, common brick, concrete masonry unit brick, reinforced concrete unit masonry, reinforced brick masonry and brick arches required for this work as indicated on the drawings.

B. Related Work Described Elsewhere:

1. Mortar and Grout: Section 04.11.00
2. Masonry Accessories: Section 04.16.00
3. Joint Sealant: Section 07.92.00

1.02 QUALITY ASSURANCE

A. General: Obtain units from one manufacturer, cured by one process and of uniform texture and color, for each type required, for each continuous area and visually related areas. Wherever concrete units are shown or scheduled to be painted, provide fine textured units.

B. Qualifications of Personnel: Use workers trained and experienced and completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

C. Provide skilled journeyman masonry foreman who shall be present at all times during execution of this portion of the work and who shall personally direct work performed under this section.

D. Codes and Standards: Comply with the requirements of the Governing Authorities and Codes for the kinds of construction shown. All masonry shall satisfy requirements of ACI 530-11/ASCE 5-11/TMS 402-11, Building Code Requirements for Masonry Structures.

1.03 SUBMITTALS

A. Samples: Within 35 calendar days after award of the Contract, and before any concrete unit masonry materials are delivered to the job site, submit one sample of each proposed concrete masonry unit to the Designer for approval.

B. Certification: Prior to delivery of concrete masonry material to the job site, deliver to the Designer a letter from the manufacturer of the proposed masonry units certifying that all such units to be delivered to the job site are in strict conformance with the provisions of this section.

C. Mock Ups: Prior to proceeding with work of this section, construct a section of masonry wall to establish for the Designer’s review and approval the general construction and appearance of the installed face brick and concrete masonry units.
D. Upon the Designer's approval of the mock up, complete required masonry construction in strict accordance with the standards reviewed and approved by the Designer in the mock ups. Mock ups to remain on job site until completion of masonry work.

PART 2 - PRODUCTS

2.01 GENERAL

A. Concrete Masonry Units: Provide manufacturer's standard lightweight aggregate units, with nominal face dimensions of 16" long X 8" high, unless otherwise shown. Concrete masonry units shall conform to the requirements of ASTM C90, open end, Type 1 and with compressive strength of 1700 psi, minimum on net area for any one unit, and not less than 1900 psi for average of 3 units. Aggregate for units shall meet ASTM C331 for lightweight aggregate. $F_m = 1900$ psi for all units.

1. Provide special shapes where shown and where required for lintels, corners, jambs, sash, control joints, headers, bonding and other special conditions. Provide bullnose block for all outside corners, except where shown. Moulded block will be required for $45^\circ$ outside corners or other angled corners.

2. Shrinkage of standard blocks shall not exceed the amount recommended in ASTM C426.

3. Water Content: At the time of delivery to the job site, concrete masonry units shall have a value, in weight of contained water, of not more than 35% of the fully saturated content for the unit tested.

4. Ship units from the factory, and store at the job site, with necessary protection to prevent increase of water content from rain and other sources.

5. Certification required under Submittals shall show results of tests made not more than 12 months prior to delivery of concrete masonry units to the job site, shall show compliance with the specified values, and shall certify that the mix design, yield per batch, and curing procedures for the units delivered to the job site will be equal to those submitted for test.

6. Curing: Cure units in a moisture controlled atmosphere or in an autoclave at normal pressure and temperature to comply with ASTM C90, Type 1 requirements.

B. Face Brick (Veneer): Allowance of $350.00/Thousand (Brick Only). Also see Specification Section 01020 for Allowances. (Brick is to match existing as closely as possible.)

C. Face and Common Brick: Standard size continuous kiln commons and shall meet specification C216, Grade SW, Type FBS. No less than 70% solid area. No part of any core shall be less than 3/4" from any brick face.

D. Accent Brick (Veneer): Brick shall be coordinated with the Project Designer.

E. Special Shapes: Provide special shape brick at corners, sills, columns caps or at details as indicated on drawings. No brick is to have exposed cores or inner faces.
2.02 MORTAR AND GROUT

A. See Section 04.11.00 of these specifications.

2.03 REINFORCEMENT

A. Provide reinforcement steel per Section 03.20.00 of these specifications and/or as shown on drawings.

2.04 LINTELS

A. ConstructLintelsWhereShownasFollows:

1. Install loose lintels of steel and other materials as shown.

2. Provide precast masonry lintels where shown and wherever openings of more than 1'-0" are shown without structural steel or other supporting lintels.
   a. Unless otherwise shown, provide one top and one bottom reinforcing bar for each 4" of wall thickness and of a size number not less than the number of feet of opening width.
   b. For hollow masonry unit walls, use specifically U-Block lintel units with reinforcing bars placed as shown or specified and grout as specified. Do not use mortar for grout.

3. Provide minimum bearing at each jamb of 4" for openings less than 4'-0" wide, and 8" for wider openings.

4. Grout masonry minimum 8" wide by thickness of wall at all lintel bearings from bottom of lintel to floor or footing below lintel.

B. Flashings for Masonry:

1. Provide concealed flashing, shown to be built into masonry. Refer to Section 04.16.00: Masonry accessories for type of flashing required. Prepare masonry surfaces smooth and free from projections which might puncture flashing.

2. Place through wall flashing on bed of mortar and cover with mortar. Seal flashing penetrations with mastic before covering with mortar. Terminate flashing 1/2" from face of wall, unless otherwise shown.

2.05 OTHER MATERIALS

A. Materials, not specifically described but required for a complete and proper installation of the work of this section, shall be as selected by the Contractor subject to the approval of the Designer.
PART 3 - EXECUTION

3.01 INSPECTION

A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 COORDINATION

A. Carefully coordinate with all other trades to ensure proper and adequate interface of the work of other trades with the work of this section.

3.03 PRODUCT HANDLING

A. Protection: Use means necessary to protect the materials of this section before, during and after installation and to protect the work and materials of all other trades.

B. Replacements: In the event of damage, immediately make repairs and replacements necessary to the approval of the Designer and at no additional cost to the Owner.

C. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls and partitions do not exceed 1/2" in any bay or 20' maximum nor 3/4" in 40' or more.

D. Variation in Cross Sectional Dimensions: For columns and thickness of walls from dimensions shown do not exceed minus 1/4" nor plus 1/2".

3.04 JOB CONDITIONS

A. Protection of Work: During erection, cover existing construction and equipment as required to keep mortar and other masonry materials from soiling existing.

B. Staining: Prevent grout or mortar from staining the face of masonry to be left exposed or painted.

C. Protect sills, ledges and projections from droppings of mortar.

D. Where masonry work will be of a patch or infill nature, match existing construction as closely as possible.

3.05 COLD WEATHER CONSTRUCTION

A. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.

B. Remove masonry determined to be frozen or damaged by freezing conditions.

C. Perform the following construction procedures when the ambient temperature falls below 40° Degrees F. and the temperature of masonry units is below 40° Degrees F. while the work is progressing.

1. Do not lay masonry units having a temperature below 20° Degrees F. Remove visible ice on masonry units before the unit is laid in the masonry.
2. Heat mortar sand or mixing water to produce mortar temperatures between 40° Degrees F and 120° Degrees F at the time of mixing. Maintain mortar above freezing until used in masonry.

3. When ambient temperature is between 25° Degrees F and 20° Degrees F use heat sources on both sides of the masonry under construction and install wind breaks when wind velocity is in excess of 15 mph.

4. When ambient temperature is below 20° Degrees F, provide an enclosure for the masonry under construction and use heat sources to maintain temperatures above 32° Degrees F within the enclosure.

5. When mean daily temperature is between 40° Degrees F and 32° Degrees F, protect completed masonry from rain or snow by covering with a weather resistive membrane for 24 hours after construction.

6. When mean daily temperature is between 32° Degrees F and 25° Degrees F, completely cover completed masonry with a weather resistive membrane for 24 hours after construction.

7. When mean daily temperature is between 25° Degrees F and 20° Degrees F, completely cover completed masonry with insulating blanks or equal protection for 24 hours after construction.

8. When mean daily temperature is below 20° Degrees F, maintain masonry temperature above 32° Degrees F for 24 hours after construction by enclosure with supplementary heat, by electric heating blankets, by infrared heat lamps or by other acceptable methods.

3.06 HOT WEATHER CONSTRUCTION

A. Implement the following requirements when the ambient temperature exceeds the following:

1. 100° Degrees F or
2. 90° Degrees F with a wind velocity greater than 30 mph.

B. Do not spread mortar beds more than 4' feet ahead of masonry. Set units within one minute of spreading mortar.

C. Wetting Masonry Units:

1. Concrete Masonry: Unless otherwise required, do not wet concrete masonry units before laying.

2. Clay and Shale Masonry: Wet clay or shale masonry units having initial absorption rates in excess of one gram per minute, per square inch, when measured in accordance with ASTM C67, so the initial rate of absorption will not exceed one gram per minute, per square inch when the units are used. Lay wetted units when surface dry.
D. Mortar: Mix all cementitious materials and aggregates between 3 and 5 minutes in a mechanical batch mixer with sufficient amount of water to produce a workable consistency. Unless acceptable, do not hand mix mortar. Maintain workability of mortar by remixing or retempering. Discard all mortar which has begun to stiffen or is not used within 2-1/2 Hours after mixing.

3.07 ERECTION

A. Bond Pattern: Unless otherwise required, construct masonry in running bond pattern.

B. Tolerances: Erect masonry within the following tolerances from the specified dimensions:

1. Dimension of Elements:
   a. In cross section or elevation -1/4" inch, +1/2" inch.
   b. Mortar Joint Thickness:
      Bed: ± 1/8" inch.
      Head: -1/4" inch, +3/8" inch.
      Collar: -1/4" inch, +3/8" inch.
   c. Grout space or cavity width -1/4" inch, +3/8" inch.

2. Elements:
   a. Variation From Level:
      Bed Joints: ±1/4" inch in 10 feet; ±1/2" inch maximum.
      Top Surface of Bearing: Wall ±1/4" inch in 10 feet; ±1/2" inch maximum.
   b. Variation from Plumb: ±1/4" inch in 10 feet; ±3/8" inch in 20 feet; ±1/2" inch in maximum.
   c. True to a Line: ±1/4" inch in 10 feet; ±3/8" inch in 20 feet; ±1/2" inch in maximum.
   d. Alignment of columns and walls (bottom versus top): ±1/2" inch for bearing walls; ±3/4" inch for nonbearing walls.

3. Location of Elements:
   a. Indicated on Plan: ±1/2" inch in 20' feet; ±3/4" inch in maximum.

4. In Placing of Reinforcement. See Article 3.3.3.2

5. If the above conditions cannot be met due to previous construction, notify the Designer.

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ISSUED: 3/13/2017
C. Placing Mortar and Units:

1. Bed and Head Joints: Unless otherwise required or indicated on the Project Drawings, construct 3/8" inch thick bed and head joints except at foundation. Construct bed joints of the starting course of foundation with a thickness not less than 1/4" inch and not more than 3/4" inch. Construct joints that also conform to the following:
   a. Fill line pin holes in exposed and below grade masonry with mortar.
   b. Unless otherwise required, tool joints with a round jointer when the mortar is thumbprint hard.
   c. Remove masonry protrusions extending 1/2" inch or more into cells or cavities to be grouted.

2. Collar Joints: Unless otherwise required or indicated on the Project Drawings, solidly fill collar joints less than 3/4" inch wide with mortar as the job progresses.

3. The placement requirements of this section and of 3.04 apply to masonry to be grouted.

4. Hollow Units: Place hollow units so:
   a. Face shells of bed joints are fully mortared.
   b. Webs are fully mortared in all courses of piers, columns, and pilasters, in the starting course on foundations, where adjacent cells or cavities are to be grouted, and when otherwise required.
   c. Head joints are mortared, a minimum distance from each face equal to the face shell thickness of the unit.
   d. Vertical cells to be grouted are aligned and unobstructed openings for grout are provided in accordance with the Project Drawings.

5. Solid Units: Unless otherwise required, solidly fill bed and head joints with mortar and:
   a. Do not fill head joints by slushing with mortar.
   b. Construct head joints by shoving mortar tight against the adjoining unit.
   c. Do not deeply furrow bed joints.

6. All Units:
   a. Place clean units while the mortar is soft and plastic. Remove and relay in fresh mortar any unit disturbed to the extent that initial bond is broken after initial positioning.
b. Cut exposed edges or faces of masonry units smooth or position such that all exposed faces or edges are unaltered manufactured surfaces.

D. Prefabricated Concrete and Masonry Items: Erect prefabricated concrete and masonry items in accordance with the requirements indicated on the Project Drawings.

E. Wall Ties: Fabricate and place ties and other reinforcement accessories in conformance with the provisions of Section 3.

F. Embedded Items and Accessories: Install embedded items and accessories where shown in the Project Drawings and in accordance with the Contract Documents.

1. Construct chases as masonry units are laid.

2. When required, place pipes and conduits passing horizontally through masonry beams or masonry walls in steel sleeves or cored holes.

3. Install pipes and conduits passing horizontally through nonbearing masonry partitions.

4. Place pipes and conduits passing horizontally through piers, pilasters, or columns.

5. Place horizontal pipes and conduits in and parallel to plane of walls.

6. Install and secure connectors, flashing, weep holes, weep vents, nailing blocks, and other accessories.

7. Install movement joints.

8. When required, install insulation.

G. Reinforcement: Place reinforcement in accordance with Section 3.03.

H. Grout: Place grout in accordance with Section 3.04.

I. Bracing of Masonry: Design, provide, and install bracing that will assure stability of masonry during construction.

J. Construction Loads: Do not apply construction loads that exceed the safe superimposed load carrying capacity of the masonry and shores, if used.

K. Masonry Protection: Cover top of unfinished masonry work to protect it from the weather.

3.08 GROUTING

A. Debris: Spaces to be grouted shall be free of mortar dropping, debris, loose aggregates, and any material deleterious to masonry grout.

B. Reinforcement: The provisions of Section 03200 apply to this section. In the spaces to receive grout, reinforcement and ties shall be in place prior to grouting.
C. Cleanouts: When grout pour exceeds 5' feet in height, cleanouts shall be provided in the bottom course of masonry in each grout pour.
   a. Where required cleanouts shall be provided adjacent to each vertical bar. In solid grouted masonry, space cleanouts horizontally a maximum of 32" inches on center.
   b. The size of cleanout openings shall be of sufficient size to permit removal of debris. The minimum opening dimension shall be 3" inch.
   c. After cleaning, close cleanouts with closures braced to resist grout pressure.

D. Placement: Place grout within 1-1/2 Hour from introducing water in the mixture and prior to initial set.

E. Cold Weather: The provisions of Paragraph 1.05 shall apply to this section.

F. Confinement: Grout shall be confined to the areas indicated on the Project Drawings. Material used for confinement shall permit bond between masonry units and mortar.

G. Grout Pour Height: Grout pour height shall not exceed the height given in Table I.

**TABLE I:**

<table>
<thead>
<tr>
<th>Specified grout type</th>
<th>Maximum grout pour height, ft.</th>
<th>Minimum */+ width of grout space, in.</th>
<th>Minimum + grout space dimensions for grouting cells of hollow units, in. X in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine</td>
<td>1</td>
<td>3/4</td>
<td>1-1/2 X 2</td>
</tr>
<tr>
<td>Fine</td>
<td>5</td>
<td>2</td>
<td>2 X 3</td>
</tr>
<tr>
<td>Fine</td>
<td>12</td>
<td>2-1/2</td>
<td>2-1/2 X 3</td>
</tr>
<tr>
<td>Fine</td>
<td>24</td>
<td>3</td>
<td>3 X 3</td>
</tr>
<tr>
<td>Coarse</td>
<td>1</td>
<td>1-1/2</td>
<td>1-1/2 X 3</td>
</tr>
<tr>
<td>Coarse</td>
<td>5</td>
<td>2</td>
<td>2-1/2 X 3</td>
</tr>
<tr>
<td>Coarse</td>
<td>12</td>
<td>2-1/2</td>
<td>3 X 3</td>
</tr>
<tr>
<td>Coarse</td>
<td>24</td>
<td>3</td>
<td>3 X 4</td>
</tr>
</tbody>
</table>

* For grouting between wythes. + Grout space dimension equals grout space width minus horizontal reinforcing bar diameter.

1. Grout Lift Height: Place grout in lifts not exceeding 5' feet.

2. Consolidation: Consolidate grout at the time of placement. Consolidate grout pours 12" inch or less in height by mechanical vibration or by puddling. Consolidate pours exceeding 12" inch in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.
3.09 CLEANING

A. Clean exposed masonry surfaces of all stains, efflorescence, mortar or grout droppings and debris. Use potable water and detergents to clean masonry unless otherwise acceptable.

B. Unless otherwise required, do not use acid or caustic solutions. Do not use high pressure nozzles as a method of cleaning masonry.

END OF SECTION 04.22.00
SECTION 05.12.00

PART 1 – GENERAL

1.01 DESCRIPTION

A. Work Included: Furnish, fabricate, mark for erection identification, pack crate, or otherwise properly prepare for shipment, and ship to the site all structural steel indicated on the drawings, described in these Specifications, or otherwise required for proper completion of the Work.

B. Related Work Described Elsewhere:

1. Structural Steel Erection: Section 05.12.10
2. Cold Formed Steel Framing: Section 05.40.00
3. Miscellaneous Metals: Section 05.50.00
4. Finish Painting of Structural Steel: Section 09.91.13 & 09.91.23

1.02 QUALITY ASSURANCE

A. Standards: Comply with standards specified in this Section as listed in Section 01085.

B. Qualifications of Welders: Qualify welding processes and welding operators in accordance with AWS "Standard Qualifications Procedures.

C. Source Quality Control: The Designer reserves the right to require inspection and tests in the mill and shop, conducted by an Independent Testing Agency approved by the Designer at no additional cost to the Owner.

1.03 SUBMITTALS

A. General: Comply with pertinent provisions of Section 01.30.00.

B. Manufacturer's Data: Within 35 calendar days after award of the Contract, and prior to the start of fabrication submit:

1. Producers' or Manufacturers' specifications and installation instructions for the following products. Include laboratory test reports and other data as required to show compliance with specified requirements.
   a. Structural steel (each type), including nuts and washers.
   b. High strength bolts (each type), including nuts and washers.
   c. Unfinished bolts and nuts.
   d. Structural steel primer paint.

2. Shop Drawings including complete details and schedules for fabrication and shop assembly of members. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by AWS symbols, and show size length, and type of weld. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages. Identify details by reference to sheet and detail number on the Drawings. Show all dimensions.

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ISSUED: 3/13/2017
1.04 PRODUCT HANDLING

A. Delivery and Storage: Deliver all material to the job site properly marked to identify the structure for which it is intended. Marking shall correspond to marking indicated on the Shop Drawings. Store in a manner to maintain identification and to prevent damage.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Designer and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Rolled Steel Shapes: ASTM A992.

B. Plates, Bars, Channels, Angles and S-Shape: ASTM A36.

C. Cold Formed Steel Tubing: Comply with ASTM A500, Grade B.

D. Hot Formed Steel Tubing: Comply with ASTM A501.

E. Steel Pipe: Comply with ASTM A53, Type E or S, Grade B.


G. Anchor Bolts: Comply with ASTM A36, non-headed type with heavy hexagonal nuts and washers unless otherwise indicated.

H. Unfinished Threaded Fasteners: Comply with ASTM A307, Grade A, regular low carbon steel bolts and nuts.

Provide either hexagonal, or square heads and nuts, except use only hexagonal units for exposed connections.

I. High Strength Threaded Fasteners: Heavy hexagonal structural bolts, heavy hexagon nuts, and hardened washers, shall be quenched and tempered medium carbon steel bolts, nuts and washers, complying with ASTM A325.


K. Headed Studs and Deformed Bar Anchors:

   a. Uniform diameter.
   b. Heads: Concentric and normal to shaft.
   c. Weld End: Chamfered and solid flux.

   a. Straight, unless otherwise indicated.
   b. Solid flux.
3. After welding, free from substance which would interfere with function as anchor or bond to deformed anchors, bars.

4. Acceptable Manufacturers: Erico/Jones Stud Welding Division, Dayton, Ohio; TRW, Inc./Nelson Division, Lorain, Ohio; and Omark Industries, Inc./KSM Fastening System Division, Moorestown, NJ.

PART 3 – EXECUTION

3.01 FABRICATION

A. Shop Fabrication and Assembly:

1. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the approved Shop Drawings. Provide camber in structural members as shown. Fabrication shall be by a AISC Certified Shop.

2. Properly mark and match mark materials for field assembly and for identification as to structure and site for which intended. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.

3. Where finishing is required, complete the assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defect.

B. Connections:

1. Bolts and washers of all types and sizes required shall be provided for completion of all field erection.

2. High Strength Bolted Construction: Install high strength threaded fasteners in accordance with AISC “Specifications for Structural Joints” using ASTM A325 bolts unless noted otherwise.

3. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welded work.

4. Assemble and weld built up sections by methods which will produce true alignment of axes without warp.

C. Steel Wall Framing: Select members which are true and straight for the fabrication of steel wall framing. Straighten as required to provide uniform, square, and true members in the completed wall framing.

D. Holes for Other Work:

1. Provide holes required for securing other work to structural steel framing, and for the passage of other work through steel framing members, as shown on the final Shop Drawings. Provide threaded nuts welded to framing, and other specialty items as shown to receive other work.
2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

E. Splicing: Splice members only where indicated unless, with the Designer approval, splices not indicated would result in lower costs due to reduced shipping costs. Submit structural calculations signed by an Engineer of Record licensed where the fabricator is located, for all splices not indicated.

F. Gas Cutting: Do not use gas cutting torches for correcting fabrication errors in the structural framing. Cutting will be permitted only on secondary members as acceptable to the Designer. Finish gas cut sections equal to a sheared appearance when gas cutting permitted.

3.02 SHOP PAINTING

A. General:

1. Shop paint all structural steel work, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel which is partially exposed on the exposed portions and the initial 5 cm (2") of embedded areas only.

2. Do not paint surfaces which are to be welded or high strength bolted with friction type connections.

3. Apply two coats of paint to surfaces which are inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.

4. Beam and plate lintels, angle lintels and other rolled shapes in exterior walls are to be galvanized completely before shipping. Galvanizing to conform to ASTM A123.

B. Surface Preparation: After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale, and splatter, slag, and flux deposits. Clean steel in accordance with Steel Structures Painting Council recommendations as follows:

1. SP-2 "Hand Tool Cleaned" for steel scheduled or specified to receive primer.

C. Painting: Immediately after surface preparation, apply "Tnemec" 10-99 Gray metal primer or "Southern Coatings", 1-2483 or Rustaloy, LSC gray primer in accordance with the manufacturer's recommendations and at a rate to achieve a dry film thickness of not less than 2.5 mils. Cover joints, corners, edges and all exposed surfaces.

3.03 SHOP QUALITY CONTROL

A. General: The testing and inspection service shall perform the following:

1. Inspect high strength bolted connections, visually inspect welded connections, perform required tests and inspections, and prepare and submit to the Designer test report.

2. Submit test reports in triplicate to the Designer.
3. Review mill tests reports, verify identity of steel with respect to mill test reports and, if found to comply with Specification requirements, so certify to the Designer.

4. If steel is not accompanied by test reports, or test reports fail to verify compliance, perform additional tests in compliance with procedures specified in the appropriate ASTM specifications and prepare test reports.

5. Conduct and interpret the tests and state in each report whether the test specimens comply with the requirements.

6. Inspect structural steel at the plant before shipment; however, the Designer reserves the right, at any time before final acceptance, to reject material not complying with specified requirements.

7. Verify dry mil thickness of shop prime coat.

8. Perform additional tests, at Contractor's expense, as may be necessary to reconfirm any noncompliance of the original work, and as may be necessary to show compliance of corrected work.


10. Shop Welding: Inspect and test during fabrication of structural steel assemblies, as follows:
    
a. Certify welders and conduct inspections and tests as required. Record types and locations of all defects found in the work. Record work required and performed to correct deficiencies.

    b. Perform visual inspection of all welds.

B. Access: Provide access for the Testing Agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.

3.04 INSPECTION

A. Inspection by the Designer shall in no way relieve the Contractor from his responsibility to furnish satisfactory workmanship and the right is reserved to reject any workmanship, at any time before the final acceptance of the work if, in the opinion of Designer, the workmanship does not conform to the requirements of the contract. The inspector shall have access at all times and at all points where the work is being done or where material is stored and shall have full authority to reject or have corrected any work or material that fails to conform to the terms of the contract.

END OF SECTION 05.12.00
SECTION 05.12.10

STRUCTURAL STEEL ERECTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Erect all structural steel shown on the Drawings, specified herein, or otherwise required for the complete facility.

B. Definition: "Structural Steel is that work defined in the AISC "Code of Standard Practice" and as otherwise shown on the drawings or specified herein."

C. Related Work Described Elsewhere:
   1. Furnishing of Structural Steel: Section 05.12.00
   2. Finish Painting Structural Steel: Section 09.91.13 & 09.91.23

1.02 QUALITY ASSURANCE

A. Standards: Comply with standards specified in this Section and as listed in Section 01.40.00.

B. Qualifications of Welders: Qualify welding processes welding operators in accordance with AWS "Standard Qualification Procedure".

1.03 SUBMITTALS

A. General: Comply with pertinent provisions of Section 01.30.00.

B. Manufacturers Data: Within 35 calendar days after award of Contract, submit Manufacturer's data on proposed shrinkage resistant grout.

C. Shop Drawings:
   1. Refer to Paragraph 1.03.B.2 in Specification Section 05.12.00.
   2. Should the Contractor elect to change sequence of erection or other details of field erection, submit necessary revised Shop Drawings to the Engineer of Record for review.

D. Surveys of Structural Steel: In accordance with the schedule agreed upon by the Contractor and the Engineer of Record, submit three copies of surveys prepared in accordance with Paragraph 1.03.C.2. above.

1.04 PRODUCT HANDLING

A. Protection: Store materials to permit easy access for inspection and identification. Keep steel members off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer of Record and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Refer to Section 05.12.00 for materials specified therein for erection under this Section. Provide all other materials required for completion of erected structural steel including tie rod assemblies.

B. Headed Stud Type Shear Connectors: Comply with ASTM A108, Grade 1015 or 1020, cold finished carbon steel, with dimensions complying with the AISC Specifications.


D. Metallic Non-Shrink Grout: Design is based on use of "Embeco" high strength non-shrink metallic grout manufactured by Master Builders. Metallic, non-shrink grout shall be that upon which design is based or an equal approved by the Structural Engineer.

2.02 FABRICATION

A. High Strength Bolted Construction: Install high strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts", using A325 bolts only.

B. Welded Construction:
   1. Comply with AWS Code for procedures, appearance, quality of welds, and for methods used in correcting welding.
   2. Assembly and weld built up sections by methods which will produce true alignment of axes without warp.

C. Steel Wall Framing: Selected only those members which are true and straight for the fabrication of steel wall framing. For members which are not straight and true, use all means necessary and straighten as required to provide uniform, square, and true members in the completed wall framing.

D. Holes for Other Work:
   1. Should holes be required in addition to those provided under Section 05.12.00, provide all such holes and strengthen the area as required to compensate, always subject to the approval of the Architect/Engineer.
   2. Provide threaded nuts welded to framing, and other specialty items as required, to receive other work.
   3. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates as required.
PART 3 - EXECUTION

3.01 INSPECTION

Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to proper and timely completion of work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 ERECTION

A. General: Comply with AISC Specifications and Code of Standard Practice, and all OSHA Requirements for erection of structural steel and as specified herein.

B. Surveys: Establish permanent bench marks necessary for the accurate erection of structural steel. Check elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar items, before erection proceeds.

C. Temporary Shoring and Bracing:
   1. Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads.
   2. Provide temporary guy lines to achieve proper alignment of the structures as erection proceeds.
   3. Remove temporary connections and members when permanent members are in place and final connections are made, including tie rod assemblies tensioned.

D. Temporary Planking: Provide temporary planking and working platforms as needed for effective completion of work of this Section.

E. Anchor Bolts:
   1. Install anchor bolts and other connectors required for securing structural steel to foundations and other in place work.
   2. Furnish templates and other devices as needed for the presetting of bolts and other anchors to accurate locations.
   3. Refer to Division 3 of these Specifications for anchor bolt installation requirements in concrete, and to Division 4 for masonry installation.

F. Setting Bases and Bearing Plates:
   1. Clean concrete and masonry bearing surfaces free from bond reducing materials, and then roughen to improve bond to surface. Clean the bottom surface of base and bearing plates.
   2. Set loose and attached base plates and bearing plates for structural members in wedges or other adjusting devices.
3. Tighten anchor bolts after the supported members have been positioned and plumbed. Do not remove wedges or shims, but, if protruding, cut off flush with the edge of the base of bearing plate prior to packing with grout.

4. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain.

5. Finish exposed surfaces, protect installed materials, and allow to cure in strict compliance with the manufacturer's instructions as approved by the Structural Engineer.

G. Field Assembly:

1. Set structural frames accurately to the lines and elevations indicated. Align and adjust the various members forming a part of a complete frame or structure before fastening permanently.

2. Clean the bearing surfaces and other surfaces which will be permanent contact before assembly.

3. Perform necessary adjustments to compensate for discrepancies in the elevations and alignment.

4. Level and plumb individual members of the structure within specified AISC tolerances.

5. Establish required leveling and plumbing measurements on the mean operating temperature of the structure. Make allowances for the difference between temperature at time of erection and the mean temperature at which the structure will be when completed and in service.


H. Gas Cutting: Do not use gas cutting torches in the field for correcting fabricating errors in the structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to the Engineer of Record. When gas cutting is permitted, finish the sections equal to the sheared appearance.

3.03 FIELD QUALITY CONTROL

A. Inspection:

1. The Testing and Inspection Agency shall visually inspect and torque wrench test a minimum of 10% of all high strength bolted connections and shall inspect and test field welded, all moment connections, and shall perform such additional tests and inspections of field work that may be required by the Designer, and shall prepare test reports for the Designer review, per Paragraph 3.03.E. below.
2. The Testing Agency shall conduct and interpret the tests and shall state in each report whether the inspected work complies with the requirements, and shall specifically state all deviations therefrom.

3. Testing and inspection costs to be included in the Contract.

B. Correction: Correct deficiencies in structural steel work which inspections and test reports have indicated to be not in compliance with the specified requirements. Perform all additional tests required to reconfirm noncompliance of the original work and to show compliance of corrected work.

C. Field Bolted Connections: Inspect in accordance with the AISC Specifications.

D. Field Welding: Inspect and test during erection of structural steel as follows:
   1. Certify welders and conduct visual inspections of all welds and inspection of moment connections as listed below. Record types and locations of defects found in the work. Record the work required to correct deficiencies.
   2. Perform Inspection of All Moment Connection Welds as Follows:
      a. Magnetic particle inspection of field welds in accordance with ASTM E109, or
      b. Radiographic inspection in accordance with AWS, or
      c. Ultrasonic inspection in accordance with AWS.

E. Welding Inspector to supply Designer with detailed reports defining all welds that have been inspected. Report to include:
   1. Date.
   2. Time.
   3. Location of Weld. (i.e. Building A, Elevation 110', Column A-1).
   4. Type of Weld.
   5. Name of Inspector.

END OF SECTION 05.12.10
SECTION 05.21.10

STEEL JOISTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Provide all items, articles, materials, operation, or methods listed, mentioned or scheduled on the drawings and/or herein, including all labor, materials, equipment and incidentals required to complete the steel joist work.

1.02 QUALITY ASSURANCE

A. Qualifications of Welders: Use only certified welders and the shielded arc process for all welding performed in connection with the Work of this Section.

B. Codes and Standards: In addition to complying with all pertinent Codes and Regulations comply with:


C. Conflicting Requirements: In the event of conflict between pertinent Codes and Regulations and the requirements of the referenced standard of these specifications, the provisions of the more stringent shall govern.

1.03 SUBMITTALS

A. Shop Drawings: Furnish detailed drawings and lists showing the mark, number, type, location, and spacings of all joists. Show bridging type work, mark, method of attachment to the joists, and anchorage at the ends. Show type of paint and all accessories and details as may be required for proper installation of joists.

B. Furnish structural design computations of all joist furnished showing loads, unit stresses used, forces and stresses in members, welding requirements, member sizes, deflection and camber.

C. Furnish copies of certified mill tests reports on all steel used for this project indicating sizes of members, yield point in pounds per square inch, ultimate strength in pounds per square inch, elongation in percent in 8" inches, bind tests results, grade of steel and chemical analysis.

D. Items in Paragraph B, and Paragraph C, above must be submitted with shop drawings before any approval or review of shop drawings will be made.

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ISSUED: 3/13/2017
E. After approval by the Designer of the design calculations submitted by the steel joist and joist girder manufacturer, there shall be no deviation or substitution of member sizes shown on the approved documents. Any substitutions will require re-submittal to the Designer for approval. Substitution of component members without Architect’s approval will be reason for rejection of the effected steel joists or joist girders.

F. Certified mill test reports are required to show the name of the steel producer, location of the producing mill, date of production, complete chemical analysis, physical properties, necessary heat numbers and a signed statement that the materials described in the submittal mill test reports will be used in fabrication of steel joists and joist girders for this particular project.

PART 2 - PRODUCTS

2.01 JOISTS AND JOIST GIRDERS

A. Conform to these specifications and equal in quality and workmanship as manufactured by Vulcraft, Valley Joist, Inc., and John W. Hancock, Jr., Inc.

B. All K-Series and LH-Series Joists must have chords fabricated from hot rolled, double angles or T-Sections. Double, round rods for bottom chord of K-Series joists is not acceptable.

C. Composite Steel Joists: Special steel joists, designed for composite construction equal to Vulcraft, VC Series. Refer to Paragraph 1.03.B.

2.02 EXTENDED ENDS

To have a load carrying capacity at least equal to the loads shown on the drawings. Extended ends shall be a continuation of bearing depth of the steel joist, or as shown on the drawings. Shop butt welded top chord extensions will not be permitted.

2.03 BOTTOM CHORD STRUTS

Provide bottom chord struts, consisting of both members of chord extended to columns and attached as shown on drawings. Bottom chord struts are required on all joists bearing on a column.

2.04 CEILING EXTENSIONS

Ceiling extensions are required on all joists that do not occur at columns unless otherwise noted on drawings.

2.05 BRIDGING

LH-Series joists shall have diagonal X-bridging and K-Series shall have continuous bridging top and bottom chord. Size of bridging according to SJI Standard Specifications, except where noted on drawings.

2.06 SHOP PAINT

Joists, bridging, anchors and accessories to be cleaned of all rust, scale and excessive weld splatter and given one shop coat of rust inhibitive paint standard with the manufacturer. Color gray.
2.07 BOLTED CONNECTIONS

Provide field bolted connections for all joist connections occurring at columns whether or not shown on drawings. If a joist is not shown framed at a column, then an extra joist shall be provided or the first joist each side of the column, within a distance of 2' feet to the column shall be field bolted to the member supporting the joist.

PART 3 - EXECUTION

3.01 FABRICATION

Fabrication of joists shall be first class workmanship. Chords to bear tight against web members that are between chords. The bend portions of diagonal web members to be completely extended into the full depth of chord angles. Bearing ends are to be true and level to a tolerance of 1/8" in 6' inches. Straightness of joists shall meet AWS Code for dimensional tolerances Section 3.5. All welding must meet AWS and AISC Codes and Specifications. Visual inspection of welds shall meet AWS profiles Figure 3.5 "Acceptable and Unacceptable Weld Profiles". Holes or slots, for field bolted connections, in top chords and bearing plates on steel joists shall be machine punched or drilled only. Holes or slots burned by acetylene/ torch will not be permitted.

Shop splices in chord members will be permitted only in accordance with the following: All chord splices will be staggered with no two (2) splices parallel and top chord will not be shop spliced directly over a bottom chord shop splice.

All chord splices must be shop welded by an approved procedure other than a simple butt joint weld by manual arc. Multiple chord splicing to utilize short or drop length materials will not be permitted.

Bearing ends shall be fabricated true, flat, level and square with the particular member upon which it bears. Bearing ends fabricated out of square and not level with bearing member are subject to rejection.

Overall general appearance of steel joists will be subject to inspection by the Designer or Inspection Agency prior to, during and after erection. Members with excessive sweep, camber, curve, distortion, off set chord splices, weld spatter, weld slag, etc. are subject to rejection.

If through an oversight or otherwise, any steel joists have been accepted which are defective or contrary to specifications and project requirements, these joists, no matter in what state of completion, are subject to rejection by the Designer. Rejected materials shall be promptly removed from the site and replaced with suitable materials at no expense to the Owner.

Joists to be thoroughly cleaned of all rust, oil, grease, dirt, slag, weld splatter, and removal of all welding sticks before painting.

3.02 HANDLING

In accordance with standard specifications. Protect joists and accessories from harmful elements when stored at job site. Store above the ground on platforms, pallets, or other supports. Keep joists free of dirt and other foreign matter.

3.03 DAMAGED JOISTS

Replace all damaged joists as instructed by the Architect/ Engineer.

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3.04 BROKEN WELDS

All joists with broken welds must be replaced.

3.05 BENT JOISTS OR MEMBERS

Bent joists or members must be straightened and reinforced if necessary to insure structural integrity of the joist.

3.06 IMPROPER CONSTRUCTION LOADS

Care should be exercised to insure that construction loads do not exceed the carrying capacity of the joists. Stacking large quantities of deck, roof materials, or pallets of masonry units on relatively few joists will not be permitted.

3.07 ERECTION


2. It is very important for erectors to know that O.S.H.A. is interpreting 29CFR-1926.751(c)2 to mean all joist forty (40') feet and longer require a row of bolted bridging to be in place before slackening of hoisting lines.

3. The Contractor is to obtain a copy of the above digest and become familiar with its requirements. The digest should be kept on job site for quick access to reference.

4. Stability Requirements:
   a. One end of all steel joists shall be attached to its support in accordance with Section 5.6. End Anchorage of the SJI Specifications, before allowing the weight of an erector on the joists. When bolted connections are used, the bolts must be snug tightened.
   b. Bolted diagonal bridging shall be installed nearest the mid-span when span of joist equals or exceeds 40' feet. Hoisting cables shall not be released until the above bolted diagonal bridging is completely installed.

END OF SECTION 05.21.10
SECTION 05.31.00

METAL ROOF DECKING

PART 1 – GENERAL

1.01 DESCRIPTION
   A. Related Sections:
      1. General Requirements: Division 1.

1.02 QUALITY ASSURANCE
   A. Comply with provisions of following Codes and Standards, except as otherwise indicated.
      1. AISI “Specification for the Design of the Cold Formed Steel Structural Members.”
      2. Steel Deck Institute (SDI), "Steel Roof Decking Design Manual."
      3. AWS “Sheet Steel in Structures, Specification for Welding” AWS D1.3.
   B. Qualify welding processes and operations in accord with AWS “Standard Qualification Procedure.”

1.03 SUBMITTALS (See Division 1)
   A. Shop Drawings:
      1. Complete layout showing types of deck panels, anchorage, supplementary framing, cut openings, accessories, deck gauges and thickness.
   B. Product Data:
      1. Manufacturer’s load tables for deck to be furnished on this project.
   C. Samples: Not required for Designer review.
   D. Project Information: Not required for Designer review.
   E. Contract Closeout Information: Not required for Designer review.

1.04 DELIVERY, STORAGE AND HANDLING
   A. Protect materials from rusting, dirt or damage.

1.05 JOB CONDITIONS
   A. Do not overload supporting members. Until the entire assembly is complete, the structural elements may not be stable or capable of supporting Code or stated design loads.
PART 2 – PRODUCTS

2.01 METAL ROOF DECKING

A. Acceptable Products:

1. Metal Roof Decking 1-1/2" Inch Deep:
   a. Base:
      1. Consolidated Systems, Inc., Type F.
      2. Vulcraft, Type 1.5F.
      3. Wheeling Corrugating Co., Type F.

2. Metal Roof Decking 3" Inch Deep:
   a. Base:
      1. Consolidated Systems, Inc., Type N.
      2. Vulcraft, Type 3N
      3. Wheeling Corrugated Co., Type N.

B. Metal Roof Decking: Rib Type, sheet steel, 20 gauge, minimum, with minimum uncoated thickness of 0.0358 inch.

   1. Shop Painted.
   2. Painted Decking: ASTM A611, Grade C.

C. Paint for Metal Deck: Baked on, rust inhibitive paint.

   1. Apply to chemically cleaned and phosphate chemical treated metal surfaces.
   2. Repair Paint: Same as paint used on deck.

2.02 OTHER MATERIALS

A. Welding Rod: 3/16 Lincoln Electric LH3800 E-7028.

B. Screws: Stitch Tek, 12-14 x 3/4 hex washer head with pilot point.

C. Steel Shapes, Miscellaneous: ASTM A36.

D. Galvanizing for Metal Accessories: ASTM A525 G60.

E. Galvanizing Repair Paint: High zinc dust content paint, Mil-P-21035 (ships).

F. Metal Closure Strips: Painted sheet steel, minimum 0.0358" inch thick before coating.
2.03 FABRICATION

A. Form in lengths to span 3 or more support spacings, with flush, telescoped or nested 2" inch end laps.
   1. Use deck configurations complying with SDI "Basic Design Specifications" and as indicated.

B. Form metal closure strips to configuration required to provide tight fitting closures at open ends and sides of decking.

PART 3 – EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which deck units are to be installed for conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

C. Start of installation constitutes acceptance of responsibility for correct installation and performance.

3.02 INSTALLATION – GENERAL

A. Install roof deck units and accessories as indicated.

B. Do not start placement of roof deck units until all supporting members are installed complete.

C. Place each deck unit on supporting structural frame, adjust to final position, accurately align with ends bearing on supporting members.
   1. Lap units at ends no less than 2" inch.
   2. Do not stretch or contract side lap interlocks.
   3. Place deck units flat and square and secure to framing without warp or excessive deflection.

D. Puddle weld sizes specified are effective fusion diameter of welds.
   1. Weld metal shall penetrate all layers of deck material at ends laps and have good fusion to supporting members.

E. Remove and replace decking which is structurally weak or unsound or which has burn holes due to improper welding or which Designer declares defective.

F. Cut and fit roof units and accessories around other work projecting through or adjacent to roof decking.
   1. Make cutting and fitting neat, square and trim.
2. Neatly and accurately install reinforcing at all openings except.
   a. Circular openings less than 6" inch diameter.
   b. Rectangular openings having no side dimension greater than 6" inches.

3. Reinforce openings between 6" and 12" inches with 20 gauge flat steel sheet 12" inches greater in each dimension than opening. Place sheet around opening and fusion weld to top surface of deck at each corner and each side midway between each corner.

G. Install metal closure strips for support of roof insulation.
   1. Provide where rib openings in top surface of roof decking occur adjacent to edge and openings.

   2. Weld closure strips into position.

H. Install metal closure strips at all open uncovered ends and edges of roof decking, and in voids between decking and other construction.
   1. Weld into position to provide a complete decking installation.

3.03 FASTENING OF 1-1/2" INCH DEEP DECKING

A. Secure deck units to supporting frame and side laps.

B. At All Interior Supports and at Ends of Deck Use:
   1. For 24" Inch Wide Deck: Three (3) 5/8" inch round puddle welds per deck unit.

   2. For 30" Inch and 36" Inch Wide Deck: Four (4) 5/8" inch round puddle welds per deck unit.

C. At perimeter supports use 5/8" inch round puddle welds at 6" inch on center.

D. At side laps use No. 12 Hex Head Screws at 24" inch on center.

3.04 FASTENING OF 3" DEEP DECKING

A. Secure Deck units.

B. At all interior supports and at ends of deck for 24" wide deck use four (4) 5/8" round puddle welds per deck unit.

C. At perimeter supports use 5/8" inch round puddle welds at 6" on center.

D. At side laps use No. 12 Hex Head screws at 24" on center.
3.05 CLEAN AND TOUCH UP

A. Wire brush, clean and paint scarred areas, welds and rust spots on top surfaces of decking units and supporting steel members.

B. Touch up damaged galvanized surfaces with galvanizing repair paint applied in accordance with manufacturer's instruction.

C. Touch up shop painted surfaces with same paint used in shop, as recommended by Deck Manufacturer.

END OF SECTION 05.31.00
SECTION 05.32.50

NON-COMPOSITE (INVERTED) STEEL FLOOR DECK

PART 1 - GENERAL

1.01 SCOPE

This section shall include all materials, equipment, and labor necessary for the installation of steel concrete form for floors over steel beams, or walls in accordance with the specifications and drawings.

PART 2 - PRODUCTS

2.01 STEEL CONCRETE FORM

Steel concrete form shall be fabricated from high strength steel sheets conforming to ASTM A446 or ASTM A611 having a minimum yield strength of 80,000 psi. Galvanized steel shall have received a protective coating of zinc conforming to ASTM A525 and Federal Specifications QQ-S-775d, Type I.

2.02 DESIGN

Maximum fiber stress shall not exceed 30,000 psi under a total dead and live load. Deflection shall not exceed 1/240 of the span. Minimum section properties shall be l=0.212 in 4/ft.; Sp=0.247 in 3/ft. and Sn=0.234 in 3/ft. Minimum depth of form to be 1-1/2" inch and minimum thickness of metal shall be 0.0358 inches.

2.03 ACCESSORIES

Welding washers shall be furnished by Steel Form Manufacturer.

2.04 ACCEPTABLE MANUFACTURERS

2. Vulcraft: Type 1.5C Conform 20 Ga.

PART 3 - EXECUTION

3.01 FORM

Form shall be placed with the ribs perpendicular to the supports. End laps shall be a minimum of 2" inches and shall always occur over supports. All sheets shall be welded to the structural supports through welding washers. Weld pattern shall be Pattern 'B' as recommended by Steel Deck Institute.

Concrete admixtures containing calcium chloride shall not be used over galvanized deck.

Deck shall be of sufficient length to bear on three (3) supports, (minimum of two (2) spans.)

END OF SECTION 05.32.50

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SECTION 05.40.00

COLD FORMED STEEL FRAMING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work: All axially or wind loaded light gauge steel studs, track, joists, trusses, bridging, purlins, and related accessories as indicated on the Contract Drawings and specified herein.

B. Related Work Described Elsewhere:

1. Lumber and Rough Carpentry: Section 06.10.00
2. Metal Framing: Section 09.22.16

1.02 QUALITY ASSURANCE

A. Inspection and Quality Control:

1. Contractor shall provide effective full time quality control over all fabrication and erection activities.

2. As directed by Designer, Owner's Testing Agency may inspect the maintenance of a Quality Control Program including spot checking weldments and welding procedures in accordance with A.W.S. Standards.

3. Steel framing manufacturer shall provide a qualified representative for periodic on site review of fabrication and installation in accordance with Manufacturer's Recommendations.

4. Inspection by Owner's Testing Agency is not intended to be comprehensive or complete. Full responsibility for Quality Control shall remain with the General Contractor.

B. Standards:

1. Work shall meet the Requirements of the following Standards:
   e. All pertinent Federal, State and Local Codes.
2. The most stringent requirements shall govern in conflicts between specified Codes and Standards.

1.03 SUBMITTALS

A. Shop Drawings:
   1. Prior to framing fabrication, submit formal fabrication and erection shop drawings for Designer approval.
   2. Shop Drawings Shall Indicate:
      a. Framing with individual panel drawings for each wall and each differing condition including configuration, dimensions, materials, attachments, and panel locations. Sections of each load bearing wall and associated detailed connections shall be provided.
      b. All member gauges, spacings and sizes.
      c. Shop and field assembly details including cut and connections.
      d. Type and location of welds, screws, clips, bolts and fastening devices.

B. Structural Calculations:
   1. Submit recommended structural design with supporting calculations as prepared by manufacturer for approval by Engineer of Record, Designer or both. Calculations and drawings to be stamped by a Engineer of Record licensed in the State of the Project.

1.04 PRODUCT HANDLING

A. Protection: Upon delivery, material shall be protected from rain and snow by impervious covering or shelter.

B. Keep steel members off the ground, using pallets, platforms or other supports. Protect steel members and package materials from corrosion and deterioration.

PART 2 - PRODUCTS

2.01 GENERAL

A. All framing members shall be manufactured and supplied by and be of the type and size as shown on the plans, manufacturer shall be a member of SSMA.

B. Sizes are based on the Steel Stud Manufacturers Association (SSMA), "Product Technical Information" guide.
2.02 MATERIALS

A. Hot-Dipped Galvanized Materials (unless otherwise noted on Drawings):
   1. All galvanized studs and joists 12 (97 mil), 14 (68 mil) and 16 (54 mil) gauge, shall be formed from steel that corresponds to the minimum requirements of ASTM A446, Grade D with a minimum yield of 50,000 psi, unless otherwise noted on drawings.
   2. All galvanized 18 (43 mil) and 20 (33 mil) gauge studs and joists, all galvanized track, bridging, end closures and accessories shall be formed from steel that corresponds to the requirements of ASTM A446, Grade A with a minimum yield of 33,000 psi, unless otherwise noted on drawings.
   3. All galvanized studs, joists, track, bridging and accessories shall be formed from steel having a G60 galvanized coating meeting the requirements of ASTM A525 or A924.

C. Properties: The physical and structural properties shall be considered the minimum permitted for all framing members, calculated in accordance with the latest AISI Specification shall be provided.

D. Substitutions: Any substitutions must be approved in writing ten (10) days prior to Bid Date, by the Designer or the Engineer of Record.

2.03 FABRICATION

A. Framing components may be preassembled into panels prior to erecting. Prefabricated panels shall be square, with components attached in a manner as to prevent racking.

B. All framing components shall be cut squarely for attachment to perpendicular members, or as required for angular fit against abutting members. All cutting of framing components shall be done by sawing or shearing, torch cutting is NOT acceptable. Members shall be held positively in place until properly fastened.

C. Provide insulation equal to that specified elsewhere in all double jamb studs and double header members which will not be accessible to the Insulation Contractor.

D. Axially Loaded Studs:
   1. Studs shall have full bearing against inside track web, prior to stud and track attachment.
   2. Splices in axially loaded studs is not permitted.
   3. No notching or coping of studs is allowed.
   4. Framing fabricator is to ensure punch out alignment when assembling lateral bracing and field cutting studs to length. Lateral bracing must be installed at the time the wall is erected. Failure to install bracing at this time may compromise the structural integrity of the building.
   5. Use minimum of three studs at the corner of all exterior walls.

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6. Use minimum of three studs at the intersection of all load bearing walls (exterior or interior).

7. Joist or roof member must bear directly over stud. If not, a structural member is required on top of runner track for proper bearing and anchorage.

8. Studs from floor above must bear directly over joists. If not, a structural member is required on top of joist for proper bearing.

D. Joist and Rafter:
   1. Joist or rafter member must bear directly over stud. If not, a structural member is required on top of runner track for proper bearing and anchorage.
   2. All splice requirements for joists and rafters must be determined through engineering analysis.
   3. All field holes must be reinforced. No notching or coping of joists or rafters is allowed unless stated in the shop drawing package.
   4. Joist or rafter bridging must be installed at the time the floor or roof is erected. Failure to install bracing at this time may compromise the structural integrity of the building.

E. Headers:
   1. All headers/built-up beams are to be constructed with UNPUNCHED material only.
   2. Splicing of headers is not allowed.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Inspection: Prior to installation inspect work of all other trades. Verify that all such work is complete and accurate to the point where this installation may properly commence in strict accordance with framing shop drawings.

B. Discrepancies:
   1. Immediately notify Architect/Engineer of all discrepancies.
   2. Do not proceed with installation in areas of discrepancies until such discrepancy has been fully resolved.

3.02 ERECTION

A. Walls;
   1. Erect framing and panels plumb, level and square in strict accordance with the approved shop drawings.
2. Handling and lifting of prefabricated panels shall be done in a manner as to not cause distortion in any member.

3. Track shall be securely anchored to the supporting structure as shown on the fabrication and erection drawings.

4. At track butt joints, abutting pieces of track shall be securely anchored to a common structural element, or they shall be butt welded or spliced together.

5. Studs shall be plumbed, aligned and securely attached to the flange or webs of both upper and lower tracks.

6. Jack studs or cripples shall be installed below window sills, above window and door heads, at free standing stair rails and elsewhere to furnish support, and shall be securely attached to supporting members.

7. Wall studs bridging shall be attached in a manner to prevent stud rotation. Bridging rows shall be spaced according to the manufacturer's recommendation. Without supportive data, the minimum bridging shall be 5'-0" on center for wind loaded walls and 3'-4" on center for axial loaded walls.

8. Framed wall openings shall include headers and supporting studs as shown on the plans.

9. Temporary bracing shall be provided until erection is completed.

10. Provide stud walls at locations indicated on plans as "shear walls" for frame stability and lateral resistance.

11. Provision for structural vertical movement shall be provided where indicated on the plans using a vertical slide clip or other means in accordance with Manufacturers recommendations or as indicated on the drawings.

12. Provide strap X-Bracing, Size 4" x 54 mil, locations as shown on plans. Provide connections to fully develop strength capacity of straps.

B. Cold Formed Steel Lintel:

1. Lintel shall be located directly over bearing studs or a load distribution member shall be provided at the top track.

2. Provide web stiffeners at lintels.

END OF SECTION 05.40.00
SECTION 05.50.00

MISCELLANEOUS METAL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: All miscellaneous iron and steel items not specifically described in other sections of these specifications but required for a complete and operable facility including, but not limited to, anchors, anchor bolts, angle framing, channel door frames, lintels, pipe railings, bearing plates, grating and other miscellaneous iron and steel items shown on drawings.

B. Related Work Described Elsewhere:
   1. Concrete Reinforcement: Section 03.20.00

1.02 QUALITY ASSURANCE

A. Qualifications of Welders: Use only certified welders and the shielded arc process for all welding performed in connections with the work of this section.

B. Codes and Standards: In addition to complying with all pertinent Codes and Regulations, comply with:

C. Conflicting Requirements: In the event of conflict between pertinent Codes and Regulations and the requirements of the referenced standards or these specifications, the provisions of the more stringent shall govern.

1.03 SUBMITTALS

A. Shop Drawings:
   1. Within 35 days after award of contract, prior to start of fabrication and before any miscellaneous metal is delivered to the job site, submit shop drawings to the Designer for approval in accordance with Section 01.30.00 of these specifications.
   2. Show all locations, markings, quantities, materials, sizes, and shapes; and indicate all methods of connection, anchoring, fastening, bracing and attaching to the work of other trades.

B. Proof of Compliance: Upon completion of this portion of the work, and as a condition of its acceptance, deliver to the Designer a letter signed by an official of the miscellaneous metal fabricating and installing firm or firms certifying that all miscellaneous metal was furnished and installed in complete accordance with this section of these specifications.
1.04 PRODUCT HANDLING

A. Protection: Use all means necessary to protect miscellaneous metal before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Designer and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 STEEL BEAM, PLATE AND ANGLE LINTELS

All steel beam and angles shall be new, free from rust, and conforming with the requirements of ASTM A36. Install as lintel for new door openings as indicated on drawings. All lintels and beams set in, or in contact with exterior surfaces are to be galvanized after fabrication. Galvanize in accordance with ASTM A123. Provide channel door frames where shown on Drawings.

2.02 OTHER EQUIPMENT

Provide miscellaneous metal items as required for construction and installation of other work, including shelf angles, bearing plates, inserts, anchorage devices, fasteners, and related items.

2.03 FABRICATED EQUIPMENT

Provide fabricated miscellaneous metal items from structural steel shapes, plates, bars, or tubing. Steel plates, shapes, and bars shall comply with ASTM A36. Steel tubing shall comply with ASTM A500, Grade B. Steel pipe shall comply with ASTM A53. Galvanized steel sheets shall be ASTM A526 with ASTM A525, Grade G90 zinc coating.

2.04 BOLLARDS

Bollards shall be fabricated from galvanized steel pipe and shall be filled with concrete. Grind all welded joints smooth creating a 1/8" radius on top edge.

2.05 STEEL LADDER

Steel ladder to roof hatch and elevator pit shall comply with ANSI A14.3. Side rails shall be continuous steel flat bars. Bar rungs shall be 3/4" diameter round steel bars, spaced 12" o.c.

2.06 BOLTS AND NUTS

All bolts and nuts shall be new, free from rust, and conforming with the requirements of ASTM A307.

2.07 ELECTRODES

All arc welding electrodes used shall be only those specifically recommended for the purpose by the American Welding Society.

2.08 PRIMER PAINT

All primer paint shall be compatible with the finish coats specified in Section 09900 of these specifications except that, where no finish coats are required, all primer paint shall be "Tnemec 99R", a primer meeting the requirements of Federal Specification TT-P-615(d), Type 1, or an equal approved in advance by the Designer.
2.09 OTHER MATERIALS

All other materials, not specifically described but required for a complete and proper installation of miscellaneous metals, shall be new, free from rust, best quality of their respective kinds and subject to the approval of the Designer.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Inspection:
   1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that such work is complete to the point where fabrication and installation of the work of this section may properly commence.
   2. Make all required measurements in the field to insure proper and adequate fit of miscellaneous metal items.
   3. Verify that miscellaneous metal may be fabricated and installed in strict accordance with the original design and the approved shop drawings.

B. Discrepancies:
   1. In the event of discrepancy, immediately notify the Designer.
   2. Do not proceed with fabrication or installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 FABRICATION

A. Compliance: Fabricate all miscellaneous metal in strict accordance with the approved shop drawings and the reference standards.

B. Prefabrication: Insofar as possible, shop prefabricate all items complete and ready for installation.

C. Welding:
   1. Unless otherwise indicated on the drawings, weld all shop connections.
   2. Make all joints and intersections of metal tightly fitting and securely fastened.
   3. Make all work square, plumb, straight and true.

D. Holes:
   1. Drill or punch all holes required for the attachment of work of other trades and for bolted connections.
   2. Burned holes are not acceptable.
3.03 SHOP PAINTING

A. Preparation:
   1. Thoroughly clean all metal as described in Sections 09.91.13 and 09.91.23 of these specifications.

B. Painting: Shop prime all steel except:
   1. Steel to be encased in concrete.
   2. Surfaces to be welded.
   3. Contact surfaces to be high strength bolted.
   4. Steel work which will be concealed by interior finish.

3.04 ERECTION

A. Coordination: Coordinate installation schedule with the schedule of other trades to insure orderly and timely progress of the total work.

B. Compliance: Erect and install all miscellaneous metal in strict accordance with the drawings, the approved shop drawings, and the referenced standards, aligning straight, plumb, and level within a tolerance of 1 in 200.

C. Touching Up: After the erection and installation are complete, touch up all shop priming coats damaged during transportation and erection, using the priming paint specified for shop priming.

END OF SECTION 05.50.00
SECTION 05.51.10

STEEL STAIRS AND RAILINGS FOR ENCLOSED FIRE STAIRS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stairways other than the ornamental center core open stairway shall be constructed of steel framing with concrete filled metal pans.

B. Exterior handrails shall be constructed of hot dipped galvanized (after fabrication) steel pipe, with welded radius fittings.

C. Stair Designs:
   1. Enclosed Fire Stairs shall be constructed of steel framing with concrete filled metal pans.
   2. Railings at Fire Stairs: Painted steel pipe rails with woven wire mesh infill.

D. Materials:
   1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
   2. Steel Tubing: Cold formed steel tubing complying with ASTM A500.
   3. Steel Pipe: ASTM A53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
   4. Rolled Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.
   5. Woven wire mesh shall be 10 gauge “intercrimp” galvanized steel square mesh by the McNichols Company or equal. Edge mesh ends pass through minimum .162” diameter face holes in channels at 2” o.c., with sheet metal “twist nuts” on each edge wire end inside channels.

END OF SECTION 05.51.10
PART 1  GENERAL

1.01  SECTION INCLUDES
A.  Wall mounted handrails.
B.  Stair railings and guardrails.
C.  Free-standing railings at steps.
D.  Balcony railings and guardrails.

1.02  RELATED REQUIREMENTS

1.03  REFERENCE STANDARDS
C.  ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

1.04  SUBMITTALS
A.  See Section 01.30.00 - Administrative Requirements, for submittal procedures.
B.  Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

PART 2  PRODUCTS

2.01  RAILINGS - GENERAL REQUIREMENTS
A.  Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.
B.  Allow for expansion and contraction of members and building movement without damage to connections or members.
C.  Dimensions: See drawings for configurations and heights.
D.  Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
E.  Provide slip-on non-weld mechanical fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.02  STEEL RAILING SYSTEM
A.  Steel Tube: ASTM A500/A500M, Grade B cold-formed structural tubing.
B.  Steel Pipe: ASTM A53/A53M, Grade B Schedule 80, black finish.
C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
D. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.
E. Straight Splice Connectors: Steel concealed spigots.
F. Galvanizing: In accordance with requirements of ASTM A123/A123M.

2.03 FABRICATION
A. Accurately form components to suit specific project conditions and for proper connection to building structure.
B. Fit and shop assemble components in largest practical sizes for delivery to site.
C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
D. Welded Joints:
   1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
   2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
   3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

PART 3 EXECUTION - NOT USED

END OF SECTION 05.52.13
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Formed metal floor, mezzanine, and stair tread gratings.
   B. Perimeter closure.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS
   E. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric); 2012.
   F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.

1.04 SUBMITTALS
   A. Product Data: Provide span and deflection tables.
   B. Shop Drawings: Indicate details of component supports, openings, perimeter construction details, and tolerances.
      1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
   D. Manufacturer's Installation Instructions: Indicate special requirements for opening and perimeter framing.

1.05 QUALITY ASSURANCE
   A. Designer Qualifications: Design gratings and plates under direct supervision of a licensed Professional Engineer experienced in design of this type of work.
   B. Designer Qualifications: Design gratings and plates under direct supervision of a Professional Structural Engineer experienced in design of this type of work and licensed in Tennessee.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS
   A. Conform to applicable code for loading requirements.
   B. Maximum Allowable Deflection Under Live Load: 1/240 of span; size components by single support design.
   C. Maximum Spacing Between Bars: To restrict pedestrian shoe heels.
2.02 MATERIALS
A. Steel Framing: ASTM A36/A36M shapes, galvanized per ASTM A123/A123M.
B. Cross Bars: ASTM B211 (ASTM B211M) solid bars.
C. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

2.03 ACCESSORIES
A. Fasteners and Saddle Clips: Galvanized steel:
B. Perimeter Closure: Of same material as grating.

2.04 FABRICATION

2.05 FINISHES
A. Galvanizing for Steel Shapes: ASTM A123/A123M.
B. Galvanizing for Steel Hardware: ASTM A153/A153M.
C. Non-Slip Surfacing: Aluminum oxide.

PART 3 EXECUTION -- NOT USED

END OF SECTION 05.53.05
SECTION 05.62.10

ALUMINUM EXTERIOR RAILING SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description: Furnish and install aluminum railing systems as shown on the drawings and as manufactured by Sapa Profiles, Inc. (Portland, OR), or equal, that meet the requirements of the plans and specifications.

B. Codes and Standards: Rails shall conform to applicable portions of governing codes and standards.

C. Materials:

1. Aluminum: Rails and balusters shall be extruded Schedule 40 (standard) pipe as shown for the designated railing type. Extruded aluminum profiles shall be of the design and dimensions shown and specified. All extruded parts shall be made from high strength 6005-T5 aluminum alloy, and shall conform to American Society for Testing and Materials (ASTM Specification B221 for Aluminum Wire, Rod, Bar, Shapes, and Tube: Extruded.

2. Stainless Steel: Expansion pins shall be made of Type 304 stainless steel and shall conform to American Society for and Materials A-276-00ae1, A582/582M-95b (2000).

D. Finishes on Aluminum:

1. Bronze Anodic Finish for 3rd Floor Promenade Balcony Railing: All aluminum parts and members shall receive an Architectural Class I bronze anodic coating, a .07 mil or thicker coating depth. These finishes shall conform to the American Architectural Manufacturers Association (AAMA) designation AA-M10C22A43.

2. Ground Level Railings: Clear anodized aluminum finish.

E. Submittals: Before fabricating the railing, the Contractor shall submit a digital copy (through the blsshopdrwgs@bilsrch.com) of the shop plans, showing complete dimension and details of fabrication and materials for the Engineer’s approval.

F. Workmanship:

1. Railing shall be a welded system with no visible surface welds at baluster connections. Balusters shall fit tightly into and bottom rails.

2. Workmen experienced in fabrication of aluminum railing shall perform work according to the approved shop drawings welding shall be performed by certified welders in accordance with American Welding Society D1.2-97.
3. Welding of aluminum shall be in accordance with Section 5 of the latest AASHTO standard specification, American Welding Society D1.2-97.

4. Cutting shall be done by sawing or milling and all cuts shall be smooth and true.

5. Pipe railing, splices, cover plates, and bottom channels shall be bent to the horizontal curve where the radius of curve is less than 200 feet.

6. Materials shall be protected during transportation and installation to avoid damage.

G. Installation:

1. Railings shall be installed accordance with approved drawings.

2. When properly installed, railing shall be parallel to grade with balusters normal to grade and shall be adjusted to create overall line and grade that is pleasing to the eye.

3. Anchor bolts shall be either adhesive or wedge type and shall be positioned with a template to ensure that bolt spacing match with mounting hole spacing.

4. Where specified, cover plates shall fit the bottom channel tightly after being snapped into position.

END OF SECTION 05.62.10
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Decorative stairs.
   B. Railing and guardrail assemblies.
   C. Wall-mounted handrails.

1.02 REFERENCE STANDARDS
   G. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

1.03 ADMINISTRATIVE REQUIREMENTS
   A. Pre-Installation Meeting: Schedule and conduct a preinstallation meeting one week before starting work of this section. Attendees shall include, but not be limited to:
      1. Contractor.
      2. Manufacturer's representative.
      3. Architect.
      4. Owner's representative.
      5. Other subcontractors of adjacent work.

1.04 SUBMITTALS
   A. Product Data: Submit manufacturer's product data including description of materials, components, finishes, fabrication details, glass, anchors, and accessories.
B. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, brazed connections, transitions, and terminations.

C. Test Reports: Submit test reports from an independent testing agency showing compliance with specified design and performance requirements.

D. Manufacturer's Installation Instructions.

E. Maintenance Data: Manufacturer's instructions for care and cleaning.

F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installing decorative stairs and railing systems and acceptable to manufacturer.

B. Templates: Supply installation templates, reinforcing and required anchorage devices.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in factory provided protective coverings and packaging.

B. Protect materials against damage during transit, delivery, storage, and installation at site.

C. Inspect materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.

D. Prior to installation, store materials and components under cover, in a dry location.

1.07 FIELD CONDITIONS

A. Do not install railings until project is enclosed and ambient temperature of space is minimum 65 degrees F and maximum 95 degrees F.

B. Maintain ambient temperature of space at minimum 65 degrees F and maximum 95 degrees F for 24 hours before, during, and after railing installation.

1.08 WARRANTY

A. Warranty: Manufacturer's standard one year warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 METAL STAIRS

A. Decorative Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.

1. Regulatory Requirements: Provide stairs and railings complying with the most stringent requirements of local, state, and federal regulations; where requirements of the contract documents exceed those of regulations, comply with the contract documents.

2. Handrails: Comply with applicable accessibility requirements of ADA Standards.

3. Structural Design: Provide complete stair and railing assemblies complying with the following:

   a. Stair Capacity:

      1) Live Load: Uniform live load of 100 lb/sq ft and a maximum concentrated load of 300 lb with deflection of stringer or landing framing not to exceed 1/360 of span.

      2) Dead Load: Weight of stair, associated railing system, any concrete fill, cladding and other finishes.
3) Deflection Limits: Deflection of stringer or landing framing not to exceed 1/360 of span.

4. Dimensions: As indicated on drawings.

5. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.

6. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.

7. Separate dissimilar metals using paint or permanent tape.

B. Metal Jointing and Finish Quality Levels:
   1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
      a. Welded Joints: Continuously welded and ground smooth and flush.
      b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
      c. Exposed Edges and Corners: Eased to small uniform radius.
      d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.

C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.02 RAILING SYSTEMS

A. Railing Systems - General: Factory- or shop-fabricated in design indicated, to suit specific project conditions, and for proper connection to building structure, and in largest practical sizes for delivery to site.
   1. Design Criteria: Design and fabricate railings and anchorages to resist the following loads without failure, damage, or permanent set; loads do not need to be applied simultaneously.
      a. Lateral Force: 75 lb minimum, at any point, when tested in accordance with ASTM E935.
      b. Distributed Load: 50 lb/ft minimum, applied in any direction at the top of the handrail, when tested in accordance with ASTM E935.
      d. Concentrated Load: 200 lbs minimum, applied in any direction at any point along the handrail system, when tested in accordance with ASTM E935.
      e. Handrails: Comply with applicable accessibility requirements of ADA Standards.
   2. Assembly: Join lengths, seal open ends, and conceal exposed mounting bolts and nuts using slip-on non-weld mechanical fittings, flanges, escutcheons, and wall brackets.
   4. Field Connections: Provide sleeves to accommodate site assembly and installation.
   5. Welded and Brazed Joints: Make exposed joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
      a. Ease exposed edges to small uniform radius.
      b. Welded Joints:
         1) Carbon Steel: Perform welding in accordance with AWS D1.1/D1.1M.
         2) Stainless Steel: Perform welding in accordance with AWS D1.6/D1.6M.

B. Structural Glass Railing System, Base-Mounted: Engineered, base supported railing system with structural glass.
   1. Configuration: Guardrail only.
   2. Top Rail: 1 by 1-1/2 inch stainless steel; No. 4 satin finish.
   3. Base Shoe, Aluminum: ASTM B221 or ASTM B221M, 6063 alloy, T5 temper; 2-1/2 inch wide by 4-1/8 inch high, rectangular profile.
   4. Glass: As specified in this section.
   5. Handrail Brackets: Same metal as railing.
   6. Stainless Steel Finish, Exposed Surfaces: No. 4 satin finish.
7. Fasteners:
   a. Attachment to Concrete:
      1) Provide anchors capable of sustaining, without failure, a load equal to four times the load
         imposed when installed in concrete, tested in accordance with ASTM E488/E488M.
   b. Attachment to Steel: Provide 24 inch center-to-center hole spacing; 1/2 inch, stainless steel, 
      socket head cap screws for drilled and tapped or drilled and bolted attachment.

C. Wall-Mounted Handrail:
   1. 1-1/4 inch IPS / 1.66 inch OD aluminum, clear anodized finish.
   2. Internal Connection Sleeves: Sleeve, material compatible with handrail and top cap material.
   3. Handrail Brackets: Manufacturer’s standard aluminum brackets.
      a. Mounting: Wall.
      b. Finish: Clear anodized.

   a. The design of the handrail bracket shall provide a 1 ½” clearance between the post and the 
      rail, and allow for adjustment of the rail to match the angle of the ramp or stairs.
   b. Handrail brackets and pipe fittings shall provide a continuous, uninterrupted gripping surface 
      with no sharp edges or projections. The bracket shall be externally connected to the post by 
      means of an anodized aluminum, tubular rivet nut, and an austenitic 302 alloy stainless steel, 
      hexagon socket, button head, cap screw.
   c. The bracket shall be connected to the underside of the rail by means of two stainless steel, flat 
      countersunk head, Type F self-tapping screws that conform to ANSI/ASME- B18.6.4.
   d. Pipe fittings shall be internally connected to the pipe by means of an internal double tang, 
      expanded by an austenitic 302 alloy stainless steel, internal/external, reverse knurl, cup point, 
      hexagon socket set screw.
   e. Pop rivets, sheet metal screws, and adhesives shall not be an acceptable fastening method.
   f. The brackets and fittings shall be of high-tensile aluminum-magnesium alloy 535.0 
      manufactured in compliance with ASTM B26, cast from high-purity ingot 535.2 conforming to 
      ASTM B179.

2.03 MATERIALS
   A. Aluminum Components: ASTM B221 or ASTM B221M.
      1. Clear Anodized Finish: Class I, AAMA 611 AA-M12C22A41 Clear anodic coating with 
         electrolytically deposited organic seal; not less than 0.7 mils thick.
   B. Stainless Steel Components:
      1. ASTM A666, Type 304.
      2. Stainless Steel Tubing: ASTM A554, Type 304, 16 gage, 0.0625 inch minimum metal thickness, 
         1-1/2 inch diameter.
      3. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.
      4. Stainless Steel Finish: No. 4 Bright Polished finish.
   C. Glass: Laminated safety glass; ASTM C1172, unless otherwise indicated.
      1. Plastic Interlayer: Minimum 0.060 inch thick.
      2. Impact Strength: Category II, tested in accordance with 16 CFR 1201.
      4. Configuration: As indicated on drawings.
      5. Edges: Ground smooth and polished.

2.04 ACCESSORIES
   A. Welding Fittings: Factory- or shop-welded from matching pipe or tube; joints and seams ground smooth.
B. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
   1. For anchorage to concrete, provide inserts to be cast into concrete for bolting anchors.
   2. For anchorage to masonry, provide brackets to be embedded in masonry for bolting anchors.
   3. For anchorage to stud walls, provide backing plates for bolting anchors.
   4. Exposed Fasteners: No exposed bolts or screws.


D. Sealant: Silicone; clear.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that substrate and site conditions are acceptable and ready to receive work.
   B. Verify field dimensions of locations and areas to receive work.
   C. Notify Architect immediately of conditions that would prevent satisfactory installation.
   D. Do not proceed with work until detrimental conditions have been corrected.
   E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates and supports for attachment of anchors.

3.02 PREPARATION
   A. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions and directions for installation of anchorages and fasteners.
   B. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

3.03 INSTALLATION
   A. Comply with manufacturer's drawings and written instructions.
   B. Install components plumb and level, accurately fitted, free from distortion or defects and with tight joints, except where necessary for expansion.
   C. Anchor securely to structure.
   D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
   E. Isolate dissimilar materials with bituminous coating, bushings, grommets or washers to prevent electrolytic corrosion.

3.04 TOLERANCES
   A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
   B. Maximum Offset From True Alignment: 1/4 inch.

3.05 FIELD QUALITY CONTROL
   A. Field Services: Provide the services of the manufacturer for field observation of installation of railings.

3.06 CLEANING
   A. Remove protective film from exposed metal surfaces.
B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents or other substances that may damage the material or finish.

C. Glass and Glazing: Clean glazing surfaces; remove excess glazing sealant compounds, dirt, and other substances.

3.07 PROTECTION
A. Protect installed components and finishes from damage after installation.
B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
   1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION 05.70.00
PART 1  GENERAL

1.01  SECTION INCLUDES
   A. Preassembled spiral stairways.

1.02  RELATED SECTIONS
   A. Section 03 30 00 - Cast-in-Place Concrete: Cast-in-Place Concrete.

1.03  SYSTEM DESCRIPTION
   A. Performance Requirements: Stair manufacturer shall engineer and fabricate stairs and railings to comply with applicable code requirements for live and dead loads, stair widths, and other sizes and configurations applicable to Work of this Section.
   
   B. Structural Performance of Handrails and Railing Systems: Engineer, fabricate, and install handrails and railing systems to withstand the following structural loads without exceeding the allowable design working stress of the materials for handrails, railing systems, anchors, and connections. Apply each load to produce the maximum stress in each of the respective components comprising handrails and railing systems.
      1. Stair treads and structure shall be capable of withstanding a uniform load of 100 lbf/sq. ft.(4.8 kPa) and a concentrated load of 300 lbf (136 kf) applied to an area of 4 sq. in.(26 sq. cm). Uniform and concentrated loads need not be assumed to act concurrently.
         a. Deflection: L/480.
      2. Top Rail of Guardrail Systems: Capable of withstanding the following loads applied as indicated:
         a. Concentrated load of 200 pounds (90.6 kg) applied at any point and in any direction.
         b. Uniform load of 50 pounds per linear foot (74.3 kg/m) applied horizontally and concurrently with uniform load of 100 pounds per linear foot (148.6 kg/m) applied vertically downward.
         c. Concentrated load need not be assumed to act concurrently with uniform loads.
      3. Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:
         a. Concentrated load of 200 pounds (90.6 kg) applied at any point and in any direction.
         b. Uniform load of 50 pounds per linear foot (74.3 kg/m) applied in any direction.
         c. Concentrated and uniform loads need not be assumed to act concurrently.
      4. Infill Area of Guardrail Systems: Capable of withstanding a horizontal concentrated load of 200 pounds (90.6 kg) applied to 1 ft2 (0.1 m2) at any point in the system.
      5. Above load need not be assumed to act concurrently with loads on top rails of railing systems in determining stress on guard.

1.04  REFERENCES
   A. NAAMM "Metal Stairs Manual."
   C. AWS D1.1 "Structural Welding Code - Steel."
   D. AWS D1.3 "Structural Welding Code - Sheet Steel."
   E. AWS "Welding Procedure and Performance Qualification."

1.05  SUBMITTALS
   A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
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. Shop Drawings:
   1. Submit shop drawings for stairs and railings.
   2. Include plans, elevations and details.
   3. Indicate floor opening details, including floor opening and stair height tolerances.
   4. Show connection and accessory items and locations for anchor and bolt installation.
   5. Indicate field welds.
   6. Include design loads, structural calculations and material properties.
   7. Shop drawings shall be signed and sealed by a Structural Engineer licensed in State in which Project is located.

D. Selection Samples:
   1. For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples:
   1. Full size, minimum 12 inches (305 mm) in length, samples for verification of tread, handrail and baluster profile and finish.
   2. For each finish product specified, two samples, minimum size 6 inches (150 mm) square representing actual product, color, and patterns.

1.06 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Manufacturer shall have produced types of stair and railing systems required for not less than ten years, with not less than five similar projects that have been in successful use for not less than five years.
   B. Installer Qualifications: Minimum five years' experience in successful installation of stair and railing systems of type specified for Project.

1.07 PRE-INSTALLATION MEETINGS
   A. Convene minimum two weeks prior to starting work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING
   A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
   B. Handling: Handle materials to avoid damage.

1.09 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 recommended limits.

1.10 SEQUENCING
   A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.
1.11 WARRANTY
A. Provide stair and railing system manufacturer's written warranty that its products are free from defects in material and workmanship for life of building and that it agrees to repair or replace items proven to be defective or refund purchase price of item.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Basis of Design: Spiral Stairs of America, which is located at: 1700 Spiral Ct.; Erie, PA 16510; Toll Free Tel: 800-422-3700; Tel: 814-898-3700; Fax: 814-899-9139; www.spiralstairsofamerica.com
B. Requests for substitutions will be considered in accordance with provisions of Section 01.25.13 - Product Substitution Procedures.

2.02 SPIRAL STAIRS WELDED UNIT
A. Style/Design: As indicated on Drawings.

2.03 COMPONENTS
A. Column: Pipe; diameter as required for design loading or as indicated on Drawings.
B. Column Cap: Match material and finish of column.
C. Metal Landing Platforms:
   1. Material: Steel.
   2. Metal Landing Platforms: 3/16 inch (4.8 mm) checker plate.
D. Well Rail: Match stair balusters and handrails.
E. Metal Treads:
   1. Metal Treads: 3/16 inch (4.8 mm) steel checker plate.
F. Metal Handrails:
   1. Material: Steel.
   2. 1-1/2 inches round.
G. Metal Balusters:
   1. Material: Steel.
H. Metal Stringers: Plates, tubing, or channels as required for compliance with performance requirements.
   1. Material: Steel.
I. Provide landing framing, connections, and other components necessary for support and installation of stairs and other components.

2.04 ACCESSORIES
A. Fasteners and Anchorage Devices: Type as recommended by stair and railing system manufacturer.
B. Welding Materials: Type required for materials being welded.
C. Galvanizing Repair Paint: High-zinc-dust content paint for re-galvanizing welds in steel, complying with SSPC Paint 20.
D. Grout: Non-metallic shrinkage-resistant grout, premixed, noncorrosive, non-staining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents.
E. Adhesive: Type as recommended by stair manufacturer for adhering [carpet] [rubber] to tread.
2.05 MATERIALS

A. Steel:
   1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
   2. 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 Grade D.
   5. Steel Tubing: ASTM A 500/A 500M (cold formed) or ASTM A 513.
   6. Hot Rolled Sheet: ASTM A 569, commercial quality, or ASTM A570, Grade 30, structural quality, unless another grade is required for design loading.
   7. Cold Rolled Sheet: ASTM A 366, commercial quality, or ASTM A 611, Grade A, structural quality, unless another grade is required for design loading.
   8. Checker Plate: Raised pattern floor plate; thickness as required by tread model specified.
   9. Tubing: Cold- or hot-formed steel tubing complying with ASTM A 500 or A 501 respectively, or as required for design loading.

2.06 FABRICATION

A. Design Rotation: Fabricate stair and railing system and well rail and platform for counterclockwise rotation in the ascending direction and to shapes and configurations indicated in Contract Documents in largest practical sizes for handling through building openings. Mark units for reassembly and coordinated installation.
B. Fabricate stair and railing system and well rail and platform to permit site assembly and installation.
C. Weld step to center column. No hubs on fully assembled stair.
D. Mill balusters to fit angle of handrail.
E. Form continuous handrails with no joints or bolts. Form elbow bends and wall returns to uniform radius, free from buckles and twists, and with smooth finished surfaces free from blemishes.
   1. Fabricate metal handrail and railing exposed ends with prefabricated end fittings.
F. Join components with concealed fasteners and concealed welds. Countersink fasteners that cannot be concealed.
G. Welded Connections: Cope and weld or use welded-in fittings. Weld connections continuously. Grind exposed welds smooth, flush, and hairline. Remove sharp or rough edges on exposed surfaces.
H. Fabricate platforms with integral nosings matching tread nosings.

2.07 FINISHES

A. Steel: Stair and railing system manufacturer's zinc-chromated reddish brown rust inhibitor.
B. Steel: Stair and railing system manufacturer's standard black acrylic enamel epoxy finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Site Verification of Conditions: Verify installation conditions previously established under other sections are acceptable for product installation in accordance with manufacturer's instructions.
B. Verify that field measurements are acceptable to suit stair assembly tolerances.
C. Verify supports and anchors are correctly and securely positioned.
D. Scheduling of installation implies that substrate and conditions are prepared and ready for product installation. Proceeding with installation implies installer's acceptance of substrate and conditions.
E. Do not begin installation until substrates have been properly prepared.
F. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 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.

3.03 INSTALLATION
A. Install stair assembly in accordance with manufacturer's instructions and approved shop drawings and in compliance with specified performance requirements.
B. Anchor components rigidly and securely to building structure, plumb and level, accurately fitted, and free from distortion or defects.
C. Fit exposed connections to form tight hairline joints.
D. Weld connections which cannot be shop welded because of size limitations.
   1. Perform field welding of steel in accordance with AWS D1.1.
   2. Field bolt and weld to match shop bolting and welding. Grind exposed joints smooth.
E. Clean field welds, bolted connections and abraded areas.
   1. Touch up with shop primer.
F. Fastening to In-Place Construction: Provide anchorage devices and fasteners where needed for securing fabricated spiral stairs to in-place construction; include threaded fasteners for concrete and masonry inserts, through bolts, lag bolts, wood screws, and other connectors as required.
G. Assemble fabricated spiral stair components, with each component aligned and in correct relation to the designed position.

3.04 FIELD QUALITY CONTROL
A. Maximum Variation from Plumb: 1/4 inch for full height of stair.
B. Maximum Variation from Level: 1/8 inch.
C. Maximum Angular Variation of Tread from True Position: 3 degrees.
D. Comply with NAAMM Metal Stairs Manual.

3.05 PROTECTION
A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 05.71.13
FABRICATED SPIRAL STAIRS

McCarty Holsaple McCarty, Inc.
East Tennessee State University
Fine Arts Classroom Building
SBC No. 166/005-08-2013

ISSUED: 3/13/2017
PART 1 -- GENERAL

1.01 SCOPE OF WORK
   A. As indicated on the drawing, provide and install aluminum railing complete with all accessories, brackets attachment and lighting devices as described in this section.

1.02 SCOPE OF WORK INCLUDED IN THIS SECTION
   A. Provide aluminum decorative illumined railing system with posts designed to mount with anchors for floor/slab anchors or inserts at cast-in-place concrete. Mounting attachments to be supplied, engineered and approved by others.
      1. Field measuring for sleeves locations, slope and lengths.

1.03 RELATED WORK SPECIFIED IN OTHER SECTIONS
   A. Section 03 30 00: Cast-in-Place Concrete
   B. Section 03 45 00: Precast Architectural Concrete
   C. Section 04 20 00: Unit Masonry
   D. Section 05 12 00: Structural Steel Framing
   E. Section 05 40 00: Cold-Formed Metal Framing
   F. Section 09 21 16: Gypsum Board Assemblies

1.04 PERFORMANCE REQUIREMENTS
   A. Railings, guards and handrails used for protection of pedestrians at open-sided stairs, ramps and floor areas used for guidance and support.

1.05 STRUCTURAL REQUIREMENTS
   A. Railing assembly shall withstand a minimum concentrated load of 200 pounds at any point and in any direction, and a uniform load of 50 pounds per foot applied horizontally and vertically downward but not concurrently.
   B. All plastic and metal infill panel shall withstand a concentrated load of 200 pounds applied horizontally on an area of 1 sq. ft. and a uniform load of 25 pounds per square foot applied horizontally but not concurrently with other loads.
   C. The strength of aluminum shall be the lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95 and the strength of Stainless Steel shall be 60 percent of minimum yield strength

1.06 QUALITY ASSURANCE
   A. Fabricator Qualifications shall furnish references listing projects of similar size and scope
   B. Installer Qualifications shall have five (5) years of relevant experience of installing ornamental iron and railing systems.
   C. Regulatory Requirements
      1. Components and installation are to be in accordance with all local, state and federal codes and jurisdictions having authority.
      2. Components and installation are to follow current ADA Section 36, ICC/ANSI A117.1, International Building Code guidelines or any local or state codes or amendments, whichever is most restrictive.
D. Furnish certification that all components and fittings are furnished by the same manufacturer or approved by the primary component manufacturer.
   1. Furnish certification that components were installed in accordance to the manufacturer’s installation requirements and engineering data to meet the specified design loads.
   2. Arrange a pre-installation meeting based on the following requirements:
   3. Prior to the beginning of work, conduct a pre-job conference at the job site with seven calendar days advance written notice ensuring the attendance by competent authorized representatives of the fabricator, building owner’s representative, architect and all subcontractors whose work interfaces with the work of this section.
   4. Review the specifications to determine any potential coordination issues, changes in scope and/or design, installation scheduling and requirements, job site conditions and procedures and/or any other information pertinent to the installation.
   5. Record the results of the conference and furnish copies to all participants.

1.07 METALS
A. Aluminum Association (AA)
   1. ABH-21 Aluminum Brazing Handbook
   2. ASD-1 Aluminum Standards and Data
   3. DAF-45 Designation System for Aluminum Finishes
   4. SAA-46 Standards for Anodized Architectural Aluminum
   5. American Architectural Manufacturers Association (AAMA)
   6. National Association of Architectural Metal Manufacturers (NAAMM) and National Ornamental and Miscellaneous Metals Association (NOMMA)
      a. Metal Stair and Finishes Manual
   7. American Welding Society (AWS)

1.08 GENERAL REFERENCES
A. American National Standards Institute (ANSI)
   2. ICC/ANSI A117.1 Accessible and Usable Buildings and Facilities.
   3. American Society for Testing and Materials (ASTM)
      c. B 211 Aluminum and Aluminum Alloy Bar and Rods
      d. B 221 Specification for Aluminum-Alloy Bars, Rods, Shapes and Tubes
      i. E 985 Specification for Permanent Metal Railing Systems and Rails for Buildings.
   4. Americans With Disabilities Act Accessibility Guidelines (ADAAG)
   5. International Code Council (ICC)
      a. International Building Code (IBC)
   6. National Fire Protection Association (NFPA)
      a. National Electrical Code (NEC)
7. Underwriters Lapidaries (UL)
   a. Underwriters Laboratories, Inc. (U.L.)

### 1.09 SUBMITTALS

**A. Delivery, Storage and Handling**

1. Deliver materials to the job site in good condition and properly protected against damage to finished surfaces.
2. Store material on site in a location and in a manner to avoid damage. Stacking shall be done in a way, which will prevent bending.
   a. Store material in a clean, dry location away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin, or polyethylene sheeting in a manner that will permit circulation of air inside the covering.
   b. Keep handling on site to a minimum. Exercise particular care to avoid damage to finishes of material.

### 1.10 WARRANTY

**A. Five-year limited warranty includes factory labor and material costs for repairing or replacing defective LED lighting parts and power supply.**

**B. Warranty coverage based on the date of Certificate of Substantial Completion. The warranty does not cover replacement parts unless the original part was defective.**

### PART 2 -- PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURER

**A. Basis of Design is based upon products manufactured or supplied by Intense Lighting; 3340 E. La Palma Avenue, Anaheim, CA. Phone: 800-961-5321. Fax: 800-961-5322. Web site: www.intenselighting.com. E-Mail: info@intenselighting.com**

**B. Subject to meeting the requirements specified, other manufacturers requesting approval to bid their products shall submit a request for substitution 10 days prior to bid date in accordance with Section 01.25.13 - Product Substitution Procedures.**

#### 2.02 MATERIALS AND FINISHES

**A. Aluminum stock shall meet the following requirements:**

1. Extruded Bars, Shapes and Moldings: Alloy 6061-T6 meeting ASTM B 221/F 221M.
2. Permanent Mold (die gravity) casting: Alloy 356 meeting ASTM D4541 - 95.
3. Casting: Alloy A356.0-T6 meeting ASTM B 26B/B26M.
4. Finish (refer to NAAMM/NOMMA Metal Finishes Manual):
   a. Anodized finish shall be Clear Anodized and shall meet requirements of AAMA 2607.1.

#### 2.03 RAILING SYSTEM

**A. Material shall conform to 2.02 and be finished in accordance with 2.02**

**B. Rails: Fabricate rails from aluminum.**

**C. Fabricate posts from aluminumum tube.**

1. Mounting: floor base plate. 6" extension into concrete, sleeved for galvanic protection from concrete.
2. Attach post to underside of railing by use of top post bracket.
   a. V-Rail LED Lighting Rail Fixture and Lamp:
      1) Source: standard brightness LED.
      2) Life (70% brightness): 50,000 hours.
4) Beam Angle: 60° Symmetric, 30° Asymmetric
5) Housing: Extruded Aluminum.
6) Mounting: Mastic tape.
7) Listings: U.L. Listed for wet or dry locations.
8) Length: 42” increments.
9) Power Requirement: 24V output
10) Power Consumption: 4.2 w/ft.
12) Input Voltage to Power Supply: 120v.
13) Temperature Range: -25° C through +55° C

b. Infill Options:
   1) Provide plastic glazing railing infill panels under provisions of Section [06 64 00].
   2) Provide perforated metals infill panels under provisions of Section [05 73 50].

2.04 FASTENERS
   A. All mechanical fasteners used in the assembly of stainless steel or aluminum railings shall be manufactured from stainless steel.
   B. 3M Scotch-Weld Epoxy Adhesive DP 190 Translucent (long term cure)
   C. Cement: Hydraulic, ASTM C 595, factory prepared with accelerator [Rockite®].

2.05 HANDRAIL BRACKETS
   A. Brackets shall be made of cast aluminum.

2.06 FIELD COORDINATION AND FABRICATION
   A. Form rail-to-end post connections and all changes in rail direction by radius elbows; field verify all conditions with dimensions shown on submittals and shop drawings.
   B. Cut material square and remove burrs from all exposed edges, with no chamfer.
   C. Make exposed joints butt tight and flush.
   D. Close exposed ends of handrail by use of end caps.
   E. For posts set in concrete, furnish matching sleeves or inserts not less than 5 inches long.
   F. Locate intermediate rails equally spaced between top rail and finished floor or center line of tread.
   G. Verify dimensions on site prior to shop fabrication.

PART 3 --EXECUTION

3.01 PREPARATION
   A. Supply items to be cast in concrete.
   B. Examine areas to receive railing system. Notify Architect if areas are not acceptable. Do not begin installation until unacceptable conditions have been corrected.

3.02 DISSIMILAR METALS
   A. When aluminum components come into contact with dissimilar metals, surfaces shall be kept from direct contact by painting the dissimilar metal with 3M Scotch-Weld Epoxy Adhesive DP 190 Translucent or other approved product.
1. When aluminum components come into contact with cement or lime mortar, exposed aluminum surfaces shall be painted with zinc chromate.

3.03 GENERAL INSTALLATION

A. Install in accordance with shop drawings and manufacturer’s instructions at locations indicated on the drawings.

B. Erect work horizontal or parallel to rake of steps or ramp, rigid, and free from distortion or defects detrimental to appearance or performance.

C. Use mechanical or adhesive joints per manufacturer’s instructions for permanently connecting railing components at nonwelded connections. Seal all recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

D. Use fully welded joints for permanently connecting railing components at welded connections. Comply with requirements for welded connections.

3.04 FIXED EMBEDMENT/FREE STANDING POST/ WALL MOUNTED POST

A. For railing posts with fixed embedment attachment, attach posts as indicated using fittings provided by manufacturer.

1. Position post with electrical driver over the electrical conduit stub-out. Plumb and level post as required with base level to surface.

2. Install posts in concrete with cover anchorage joint with optional metal base.

3. Install top rail and secure in place with factory fittings.

4. Continue installing posts, tubes and cut as required to fit field conditions.

5. Epoxy weld extension and swivel coupling with posts in place. Repeat above procedures for remaining assemblies.

6. Field connect electrical drivers per manufacturer’s instructions.

7. Leave anchorage joint exposed with 1/8-inch buildup, sloped away from post and provide small bead of clear epoxy sealant to accommodate cement material shrinkage.

B. For railing posts with base mounted attachment, attach posts as indicated using fittings provided by manufacturer.

1. Drill holes for anchors (supplied by others) and install post (with anchors supplied by others) spaced horizontal distance between posts at 4’0” minimum to 6’0” maximum on-center.

2. Position post with electrical driver over the electrical conduit stub-out. Plumb and level post as required with base level to surface.

3. Install top rail and secure in place with factory fittings.

4. Continue installing posts, tubes and cut as required to fit field conditions.

5. Epoxy weld extension and swivel coupling with posts in place. Repeat above procedures for remaining assemblies.

6. Field connect electrical drivers per manufacturer’s instructions.

C. For wall-mounted railing, attach brackets as indicated using fittings provided by manufacturer.

1. Provide block out in wall for electrical power supply and install conduit per manufacturer’s instructions.

2. Position bracket connected to electrical driver over the electrical conduit stub out.

3. Drill holes for anchors, machine bolts or lag bolts (supplied by others). Install brackets and secure with anchors (supplied by others).

4. Install top rail and secure in place with factory fittings.

5. Place the next bracket in line with horizontal distance between supports at 4’0” minimum to 6’0” maximum on-center.

6. Continue installing tubes and cut as required to fit field conditions.

7. Epoxy weld extension and swivel coupling with posts in place. Repeat above procedures for remaining assemblies.

8. Field connect electrical drivers per manufacturer’s instructions.
3.05 WALL MOUNTED POST WITH REMOTE POWER SUPPLY

A. For wall mounted railing, attach brackets as indicated using fittings provided by manufacturer.
   I. Position bracket over the electrical conduit stub-out at wall leading to electrical power supply.
      Plumb and level brackets as required and level to surface. Install remote power supply per
      manufacturer’s instructions and recommendation in a weather/moisture tight housing in a safe,
      secure and accessible location.
      a. Drill holes for anchors, machine bolts or lag bolts (supplied by others). Install brackets and
         secure with anchors (by others).
         1) Install top rail and secure in place with factory fittings.
         2) Place the next posts in line with horizontal distance between supports at 4’0” minimum
            to 6’0” maximum on-center.
         3) Continue installing brackets, tubes and cut as required to fit field conditions.
            (a) Epoxy weld extension and swivel coupling with posts in place. Repeat above
                procedures for remaining assemblies.
            (b) Field connect electrical drivers per manufacturer’s instructions.

3.06 PROTECTION

A. Protect railing system and finish from damage during construction.
B. Provide wood blocks and padding to prevent damage to railing members and fittings during field
   installation.
C. Provide temporary protective coverings approved by railing manufacturer. Remove protective coverings
   at the time of Substantial Completion.

3.07 CLEANING

A. As installation is completed, wash thoroughly using clean water and soap; rinse with clean water.
B. Do not use acid solution, steel wool or other harsh abrasives.
C. If stain remains after washing, remove finish and restore in accordance with NAAMM/NOMMA Metal
   Finishes Manual.
D. For anodized aluminum, anodized finish must not be removed from anodized aluminum. Re-anodizing
   can only be done by removing railing and returning it to the anodizer.

3.08 REPAIR OF DEFECTIVE WORK

A. Remove stained or otherwise defective work and replace with material that meets specification
   requirements.
B. Repair damaged finish as directed by Architect.
C. Replace defective or damaged components as directed by Architect.

END OF SECTION 05.73.00
PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. As indicated on the drawing, provide and install aluminum railing complete with all accessories, brackets attachment and lighting devices as described in this section.
   1. Division 00 Instructions to Bidders
   2. Division 01 Quality Requirements
   3. Division 03 Concrete
   4. Division 03 Structural Grout
   5. Division 04 Masonry
   6. Division 05 Metals
   7. Division 26 Lighting

1.02 SUMMARY
A. Provide aluminum decorative railing system with posts designed to mount with anchors. Mounting attachments to be supplied, engineered and approved by others.
B. Field measuring for bracket locations, and lengths

1.03 DESIGN REQUIREMENTS
A. Railings, guards and handrails used for protection of pedestrians at open-sided stairs, ramps and floor areas used for guidance and support.
B. Railing assembly shall withstand a minimum concentrated load of 200 pounds at any point and in any direction, and a uniform load of 50 pounds per foot applied horizontally and vertically downward but not concurrently.
C. All plastic and metal infill panel shall withstand a concentrated load of 200 pounds applied horizontally on an area of 1 sq. ft. and a uniform load of 25 pounds per square foot applied horizontally but not concurrently with other loads.
D. The strength of aluminum shall be the lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95 and the strength of Stainless Steel shall be 60 percent of minimum yield strength

1.04 SUBMITTALS
A. Product Datacenter
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for hooks and or open slat shelving units.
B. Shop Drawings
   1. Include typical dimensioned cross-section(s) and plan view of each differing sized unit, indicating
      a. Dimensions as shown on the drawings.
      b. Finish as shown on the drawings.
      c. Samples: For each exposed product and for each color and texture specified.
      d. Size: 12 inches
      e. Provide Qualification of Installers
   2. Shop drawings shall include the following note completed and signed by the Contractor:
      a. THE DATA SUBMITTED DOES NOT CONTAIN MATERIAL DEVIATION FROM REQUIREMENTS OF CONTRACT DOCUMENTS EXCEPT AS FOLLOWS
1.05 QUALITY ASSURANCE
A. Fabricator Qualifications shall furnish references listing projects of similar size and scope
B. Installer Qualifications shall have five (5) years of relevant experience of installing ornamental iron and railing systems.
C. Regulatory Requirements
   1. Components and installation are to be in accordance with all local, state and federal codes and jurisdictions having authority.
   2. Components and installation are to follow current ADA Section 36, ICC/ANSI A117.1, International Building Code guidelines or any local or state codes or amendments, whichever is most restrictive.
   3. Furnish documentation that all components and fittings are furnished by the same manufacturer or approved by the primary component manufacturer.
      a. Furnish documentation that components were installed in accordance to the manufacturer’s installation requirements and engineering data to meet the specified design loads.
   4. Arrange a pre-installation meeting based on the following requirements:
      a. Prior to the beginning of work, conduct a pre-job conference at the job site with seven calendar days advance written notice ensuring the attendance by competent authorized representatives of the fabricator, building owner’s representative, architect and all subcontractors whose work interfaces with the work of this section.
      b. Review the specifications to determine any potential coordination issues, changes in scope and/or design, installation scheduling and requirements, job site conditions and procedures and/or any other information pertinent to the installation.
      c. Record the results of the conference and furnish copies to all participants.
   5. Aluminum Association (AA)
      a. ABH-21 Aluminum Brazing Handbook
      b. ASD-1 Aluminum Standards and Data
      c. DAF-45 Designation System for Aluminum Finishes
      d. SAA-46 Standards for Anodized Architectural Aluminum
   6. American Architectural Manufacturers Association (AAMA)
   7. National Association of Architectural Metal Manufacturers (NAAMM) and National Ornamental and Miscellaneous Metals Association (NOMMA)
      a. Metal Stair and Finishes Manual
   8. American Welding Society (AWS)
   9. Mockups: Build mockups Indicate portion of Work represented by mockup on Drawings or draw mockup as separate element.
      a. Build mockup of section as shown on Mock-up Drawings.
      b. 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. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 PRE-INSTALLATION MEETINGS
A. Conduct the conference at the job site on a date and time set a minimum of 2 weeks in advance of beginning work.
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, Installer, system manufacturer's representative, and installers whose work interfaces with or affects the wall transition to the windows.
2. Review methods and procedures related to installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine substrate and surrounding conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of walls and windows during and after installation.
6. Review governing regulations and requirements for insurance and certificates if applicable.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the job site in good condition and properly protected against damage to finished surfaces.
B. Store material on site in a location and in a manner to avoid damage. Stacking shall be done in a way, which will prevent bending.
   1. Store material in a clean, dry location away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin, or polyethylene sheeting in a manner that will permit circulation of air inside the covering.
   2. Keep handling on site to a minimum. Exercise particular care to avoid damage to finishes of material.

1.08 PROJECT CONDITIONS

A. Installer must examine all parts of the supporting structure and the conditions under which the specified materials will be installed, and notify the Contractor or Construction Manager in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

1.09 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers, basis of design: Product specifications are based upon Intense Lighting; 3340 E. La Palma Avenue, Anaheim, CA. Phone: 800-961-5321. Fax: 800-961-5322. Web site: www.intenselighting.com. E-Mail: info@intenselighting.com. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
B. Intense Lighting-Railing only-no lighting components. Refer to Lighting Fixture Schedule for Lighted Handrailing.
   1. Approved Substitutions-refer to 01 25 13 Product Substitution Procedures.

2.02 MATERIALS

A. Aluminum stock shall meet the following requirements:
   1. Extruded Bars, Shapes and Moldings: Alloy 6061-T6 meeting ASTM B 221/F 221M.
   2. Permanent Mold (die gravity) casting: Alloy 356 meeting ASTM D4541 - 95.
   3. Casting: Alloy A356.0-T6 meeting ASTM B 26B/B26M.
   4. Finish (refer to NAAMM/NOMMA Metal Finishes Manual):
      a. Anodized finish shall be Clear Anodized and shall meet requirements of AAMA 2607.1.
2.03 RAILING SYSTEM
   A. Material shall conform to 2.02 and be finished in accordance with 2.02
   B. Rails: Fabricate rails from aluminum.
   C. Fabricate posts from aluminum tube.
      1. Mounting: floor base plate.
      2. Attach post to underside of railing by use of top post bracket

2.04 FASTENERS
   A. All mechanical fasteners used in the assembly of stainless steel or aluminum railings shall be manufactured from stainless steel.
   B. 3M Scotch-Weld Epoxy Adhesive DP 190 Translucent (long term cure)

2.05 HANDRAIL BRACKETS
   A. Brackets shall be made of aluminum.

PART 3 - EXECUTION

3.01 EXAMINATION
   A. Contractor to examine existing surfaces for squareness and plumb prior to installation.
   B. Contractor to verify that all necessary wood blocking is in place prior to installation.

3.02 PREPARATION
   A. Protect surrounding and adjacent work as required preventing damage to preceding work during execution of this work.
   B. Perform all preparation necessary for a successful installation of products as specified in manufacturer’s installation instructions.

3.03 INSTALLATION
   A. Obtain Manufacturer’s instructions for successful installation of work to be performed and become knowledgeable with all material handling and installation recommendations.
   B. Ensure full compliance with Manufacturer’s instructions in all aspects of tasks required by this work. Install products in accordance with manufacturer’s instructions at locations indicated on the drawings.
   C. Coordinate all work with other project trades to assure proper installation and provide proper accommodations for following work by other trades.
   D. For railing posts with fixed embedment attachment, attach posts as indicated using fittings provided by manufacturer.
      1. Core-drill holes not less than 6 inches deep and 3/4 inch larger than OD of post spaced at horizontal distance between posts at 4’0” minimum to 6’0” maximum on-center. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer’s written instructions.
      2. Position post with electrical driver over the electrical conduit stub-out. Plumb and level post as required with base level to surface.
      3. Install posts in concrete with cover anchorage joint with optional metal base.
      4. Install top rail and secure in place with factory fittings.
      5. Continue installing posts, tubes and cut as required to fit field conditions.
6. Epoxy weld extension and swivel coupling with posts in place. Repeat above procedures for remaining assemblies.
7. Field connect electrical drivers per manufacturer’s instructions.
8. Leave anchorage joint exposed with 1/8-inch buildup, sloped away from post and provide small bead of clear epoxy sealant to accommodate cement material shrinkage.

E. For railing posts with base mounted attachment, attach posts as indicated using fittings provided by manufacturer:
1. Drill holes for anchors (supplied by others) and install post (with anchors supplied by others) spaced horizontal distance between posts at 4’0” minimum to 6’0” maximum on-center.
2. Position post with electrical driver over the electrical conduit stub-out. Plumb and level post as required with base level to surface.
3. Install top rail and secure in place with factory fittings.
4. Continue installing posts, tubes and cut as required to fit field conditions.
5. Epoxy weld extension and swivel coupling with posts in place. Repeat above procedures for remaining assemblies.
6. Field connect electrical drivers per manufacturer’s instructions.

F. For wall mounted railing, attach brackets as indicated using fittings provided by manufacturer.
1. Provide block out in wall for electrical power supply and install conduit per manufacturer’s instructions.
2. Position bracket connected to electrical driver over the electrical conduit stub out.
3. Drill holes for anchors, machine bolts or lag bolts (supplied by others). Install brackets and secure with anchors (supplied by others).
4. Install top rail and secure in place with factory fittings.
5. Place the next bracket in line with horizontal distance between supports at 4’0” minimum to 6’0” maximum on-center.
6. Continue installing tubes and cut as required to fit field conditions.
7. Epoxy weld extension and swivel coupling with posts in place. Repeat above procedures for remaining assemblies.
8. Field connect electrical drivers per manufacturer’s instructions.

3.04 FIELD QUALITY CONTROL
A. After installation, check all work for flaws and defects.
B. Form rail-to-end post connections and all changes in rail direction by radius elbows; field verify all conditions with dimensions shown on submittals and shop drawings.
C. Cut material square and remove burrs from all exposed edges, with no chamfer.
D. Make exposed joints butt tight and flush.
E. Close exposed ends of handrail by use of end caps or support brackets as required.
F. For posts set in concrete, furnish matching sleeves or inserts not less than 5 inches long.
G. Locate intermediate rails equally spaced between top rail and finished floor or center line of tread.
H. Verify dimensions on site prior to shop fabrication.
I. Repair all defective work.
J. Remove and replace all damaged components that cannot be successfully repaired as determined by Project Architect

3.05 PROTECTION
A. Protect surfaces from damage until Date of Substantial Completion. Repair or replace damaged components that cannot be repaired to architect’s satisfaction.
B. Fabricator/Installer to provide a Maintenance kit and shall review maintenance procedures and the product warranty with the Owner's maintenance personnel upon completion of project.

3.06 CLEANING

A. Remove all protection materials.
B. Clean all surfaces following manufacturer’s recommendations prior to final project completion. Do not use harsh cleaning materials or methods that would damage finish.
C. Dispose properly of all debris generated by this work, protection materials and cleaning materials.

END OF SECTION 05.73.01
SECTION 05.75.00
DECORATIVE FORMED METAL

PART 1 GENERAL -- NOT USED

1.01 SECTION INCLUDES
   A. Interior fabrications made of formed metal sheet, secondary supports, and anchors to structure, including:
      1. Closures, trim, and filler panels.
      2. Lighting coves.
      3. Mullion cladding.

1.02 RELATED REQUIREMENTS
   A. Section 05.50.00 - Metal Fabrications: Non-decorative metal fabrications.
   B. Section 07.62.00 - Sheet Metal Flashing and Trim: Formed metal flashings and trim.
   C. Section 09.91.23 - Interior Painting.

1.03 REFERENCE STANDARDS
   E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
   R. SSPC-SP 1 - Solvent Cleaning; 2015.

100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
S. SSPC-SP 5 - White Metal Blast Cleaning; 2007.

1.04 SUBMITTALS

A. Product Data - Sheet Metal Material: 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. Specimen warranty.

B. Product Data - Metal Composite Material (MCM) Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
   1. Finish manufacturer's data sheet showing physical and performance characteristics.
   2. Storage and handling requirements and recommendations.
   3. Fabrication instructions and recommendations.
   4. Specimen warranty for finish, as specified herein.

C. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, number of anchors, supports, reinforcement, trim, flashings, and accessories.
   1. Show actual field measurements on shop drawings.
   2. Differentiate between shop and field fabrication.
   3. Indicate substrates and adjacent work with which the fabrications must be coordinated.
   4. Include large-scale details of anchorages and connecting elements.
   5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than 1-1/2 inches per 12 inches.

D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

E. Certificate: Certify that the work results of this section meet or exceed specified requirements.


G. Fabricator's Qualifications.

H. Installer’s Qualifications.

I. Maintenance Data: Care of finishes and warranty requirements.

J. Executed Warranty: Submit warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating products specified in this section.
   1. With not less than three years of documented experience.
   2. Approved by MCM sheet manufacturer.
   3. Submit contact names and phone numbers for at least three references connected with successful past projects.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section.
   1. With minimum 3 years of documented experience.
   2. Approved by fabricator.
   3. Submit contact names and phone numbers for at least three references connected with successful past projects.

C. Mock-Up: Provide a mock-up for evaluation of fabrication workmanship.
   1. Locate where directed.
   2. Provide products finished as specified.
3. Mock-up may remain as part of the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
   1. Protect finishes by applying heavy duty removable plastic film during production.
   2. Package for protection against transportation damage.
   3. Provide markings to identify components consistently with drawings.
   4. Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.

B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
   1. Store in well ventilated space out of direct sunlight.
   2. Protect from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.
   3. Store at a slope to ensure positive drainage of any accumulated water.
   4. Do not store in any enclosed space where ambient temperature can exceed 120 degrees F.
   5. Avoid contact with any other materials that might cause staining, denting, or other surface damage.

1.07 WARRANTY

A. MCM Sheet Manufacturer’s Finish Warranty: Provide manufacturer's written warranty stating that the finish will perform as follows for minimum of 5 years:
   1. Chalking: No more than that represented by a No.8 rating based on ASTM D4214.
   2. Color Retention: No fading or color change in excess of 5 Hunter color difference units, calculated in accordance with ASTM D2244.
   3. Gloss Retention: Minimum of 30 percent gloss retention, when tested in accordance with ASTM D523.

PART 2 PRODUCTS

2.01 FORMED METAL FABRICATIONS - GENERAL

A. Shop Assembly: Preassemble items to greatest extent possible. Minimize field splices and field assembly. Disassemble only as necessary for transportation and handling. Mark items clearly for assembly and installation.

B. Coordination: Match dimensions and attachment of formed metal items to adjacent construction. Produce integrated assemblies. Closely fit joints; align edges and flat surfaces unless indicated otherwise.

C. Forming: Profiles indicated. Maximize lengths. Fold exposed edges to form hem indicated or ease edges to radius indicated with concealed stiffener. Provide flat, flush surfaces without cracking or grain separation at bends.

D. Reinforcement: Increase metal thickness; use concealed stiffeners, backing materials or both. Provide stretcher leveled standard of flatness and stiffness required to maintain flatness and hold adjacent items in flush alignment.

E. Anchors: Straps, plates and anchors as required to support and anchor items to adjacent construction.

F. Supports: Miscellaneous framing, mounting, clips, sleeves, fasteners and accessories required for installation.

G. Welding and Brazing: Weld or braze joints continuously. Grind, fill or dress to produce smooth, flush, exposed surfaces. Do not discolor metal. Grind smooth, polish, and restore damaged finishes to required condition.
2.02 FORMED METAL FABRICATIONS - SHEET METAL

A. Closures, Trim and Fill Panels:
   1. Form closures from type and thickness of metal indicated.
   2. Conceal fasteners when possible.
   3. Drill and tap holes for securing to other surfaces.
   4. Provide gaskets where indicated or needed for continuous seal at adjacent surfaces.
   5. Miter or cope at corners and reinforce with bent metal plate. Form tight joints.

B. Lighting Coves: Form lighting coves from type and thickness of metal indicated. Provide cutouts for electrical wiring and fasteners. Coordinate size of coves, cutouts and anchoring system with lighting system shown on drawings.

C. Mullion Cladding: Form mullion cladding from type and thickness of metal indicated. Fit tightly to adjacent constructions.

D. Pockets for Window Treatment:
   1. Form pockets from metal of type and thickness indicated. Coordinate dimensions and attachment method with window treatment, window frames, ceiling system and other adjacent construction.
   2. Reinforce for attaching window treatment and hardware.
   3. Divide continuous pockets with built in partitions. Separate adjoining drapery and blind units, align with window Mullions and accommodate filler panel at ends of pocket.

2.03 FORMED METAL FABRICATIONS - MCM SHEET

A. MCM Sheet Fabrications, General: Assemble metal panels, fasteners, and anchors in configurations and dimensions shown on the drawings.
   1. Provide panel jointing using reveal joints and gaskets but no sealant.
   2. Anchor panels to supporting framing without exposed fasteners.

B. Panels: One inch deep pans formed of metal composite material sheet by routing back edges of sheet, removing corners, and folding edges.
   1. Reinforce corners with riveted aluminum angles.
   2. Provide concealed attachment to supporting structure by adhering attachment members to back of panel; attachment members may also function as stiffeners.
   3. Maintain maximum panel bow of 0.8 percent of panel dimension in width and length; provide stiffeners of sufficient size and strength to maintain panel flatness without showing local stresses or read-through on panel face.
   4. Secure members to back face of panels using structural silicone sealant approved by MCM sheet manufacturer.
   5. Fabricate panels under controlled shop conditions.
   6. Where final dimensions cannot be established by field measurement before commencement of manufacturing, make allowance for field adjustments without requiring field fabrication of panels.
   7. Fabricate as indicated on drawings and as recommended by MCM sheet manufacturer.
      a. Make panel lines, breaks, curves and angles sharp and true.
      b. Keep plane surfaces free from warp or buckle.
      c. Keep panel surfaces free of scratches or marks caused during fabrication.

2.04 FACTORY FABRICATED COLUMN COVERS

A. Factory Fabricated Column Covers: Factory fabricated and factory finished MCM column covers, mechanically fastened to structural support.
   1. Material: Manufacturer's standard MCM sheet.
   2. MCM Sheet Thickness: 0.24 inch core.
   3. Column Section Length: 12 feet, maximum, between horizontal joints.
   4. Fasteners: Self-drilling; ASTM A449 heat treated steel, with manufacturer's standard corrosion resistant coating.
5. Aluminum Finish: Manufacturer's standard factory applied PVDF coating.

2.05 MATERIALS

A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections exposed to view on finished units.

B. Metal Composite Material (MCM) Sheet: Two sheets of aluminum sandwiching a solid core of extruded thermoplastic material formed in a continuous process with no glues or adhesives between dissimilar materials; core material free of voids and spaces; no foamed insulation material content.
   1. Overall Sheet Thickness: 4 mm.
   2. Face Sheet Thickness: 0.19 inches, minimum.
   3. Alloy: Manufacturer's standard, selected for best appearance and finish durability.
   4. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.
   5. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
   6. Flammability: Self-ignition temperature of 650 degrees F or greater, when tested in accordance with ASTM D1929.

C. Metal Framing Members - MCM Panels: Include all sub-girts, zee-clips, base and sill angles and channels, hat-shaped and rigid channels, and furring channels required for complete installation.
   1. Provide material strength, dimensions, configuration as required to meet the applied loads applied and in compliance with applicable building code.
   2. Sheet Steel Components: ASTM A653/A653M galvanized to G90/Z275 or zinc-iron alloy-coated to A60; or ASTM A792/A792M aluminum-zinc coated to A260.
   3. Stainless Steel Sheet Components: ASTM A480/A480M.

2.06 PAINTS AND COATINGS

A. Galvanizing Repair Paint: High-zinc-dust-content paint; comply with SSPC-Paint 20, compatible with other coatings specified for galvanized metal.

B. Lacquer for Copper Alloys: Clear, acrylic lacquer specially developed for coating copper-alloy.

C. Universal Shop Primer for Ferrous Metal: Fast curing, lead and chromate free, universal modified alkyd primer; containing pigments easily distinguishable from color of zinc-rich primer.


E. Shop Primer for Galvanized Steel: Cementitious galvanized metal primer.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.07 FINISHES

A. Finishes, General: Comply with NAAMM AMP 500-06.
   1. Complete mechanical finishes before fabrication. After fabrication, finish joints, bends, abrasions and surface blemishes to match sheet.
   2. Protect mechanical finishes on exposed surfaces from damage.
   3. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
   4. Appearance: Limit variations in appearance of adjacent to one-half the range represented in approved samples. Noticeable variations in the same piece are not acceptable. Install components within the range of approved samples to minimize contrast.

B. Aluminum Finishes:
   1. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
2. High Performance Organic Coatings: AAMA 2604; multiple coats, thermally cured fluoropolymer system.
3. Color: To be selected by Architect from manufacturer's standard range.

C. Galvanized Steel Finishes:
1. Repair Galvanized Surfaces: Clean welds and abraded areas and repair galvanizing to comply with ASTM A780/A780M.
2. Factory Prime: Apply shop primer to prepared surfaces of items where field painting after installation indicated, unless indicated otherwise. Comply with requirements in SSPC-PA 1.
3. Powder-Coat Finish: Manufacturer's standard thermosetting polyester or acrylic urethane powder coating; minimum cured-film thickness of 1.5 mils.

D. Steel Finishes:
1. Surface Preparation: Comply with SSPC-SP 1; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust from uncoated steel; comply with SSPC-SP 5.
2. Pretreatment: Immediately after cleaning, apply a conversion coating of type suited to organic coating applied over it.
3. Factory Prime: Apply shop primer to prepared surfaces of items where field painting after installation indicated, unless indicated otherwise.
4. Powder-Coat Finish: Manufacturer's standard thermosetting polyester or acrylic urethane powder coating; minimum cured-film thickness of 1.5 mils.

E. Stainless Steel Finishes:
1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Comply with NAAMM AMP 500-06; grind and polish surfaces to uniform finish free of cross scratches. Run grain of directional finishes with long dimension of each item.
   a. Directional Satin: No. 4.
3. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

F. Copper Alloy Finishes: NAAMM AMP 500-06.
1. Medium Satin Finish: M32; directionally textured, medium satin.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and interfaces with other work.
B. Verify substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturer's written instructions.
C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
D. Notify Architect in writing of conditions detrimental to proper and timely completion of work. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect adjacent work areas and finish surfaces from damage during installation.
B. Deliver anchorage items to be cast into concrete or built into masonry to appropriate installer(s) together with setting templates.

3.03 INSTALLATION - SHEET METAL FABRICATIONS

A. Locate and place decorative formed sheet metal items level and plumb; align with adjacent construction. Cut, drill and fit as required to install.
B. Do not cut or abrade sheet metal finishes that cannot be completely restored in the field. Return such items to manufacturer or fabricator for required alterations and refinishing or provide new items.

C. Use concealed anchorages where possible. Provide washers where needed on bolts or screws to protect metal surfaces and make weathertight connection.

D. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers indicated.

E. Install gaskets, joint fillers, insulation, sealants, and flashings as work progresses.
   1. Make exterior decorative formed sheet metal items weatherproof.
   2. Make interior decorative formed metal items soundproof or lightproof as required.

F. Corrosion Protection: Apply permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with incompatible substrate materials. Prevent corrosion damage to material and finish.

3.04 INSTALLATION - MCM FABRICATIONS

A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.

B. Comply with instructions and recommendations of MCM sheet manufacturer and fabricator, and with approved shop drawings.

C. Install securely allowing for necessary thermal and structural movement; comply with fabricator's instructions for installation of concealed fasteners.

D. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.

E. Do not form panels in field unless required by fabricator and approved by the Architect; comply with MCM sheet manufacturer's instructions and recommendations for field forming.

F. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.

G. Where joints are designed for field applied sealant, seal joints completely with specified sealant.

H. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
   1. Variation From Plane or Location: 1/2 inch in 30 feet of length and up to 3/4 inch in 300 feet, maximum.
   2. Deviation of Vertical Member From True Line: 1/8 inch in 25 feet run, maximum.
   3. Deviation of Horizontal Member From True Line: 1/8 inch in 25 feet run, maximum.
   4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 1/32 inch, maximum.

I. Replace damaged products.
   1. Field Repairs to Finishes: Using materials and methods sufficient that repairs are not discernible when viewed at distance of five feet under typical light conditions experienced at project.

3.05 CLEANING

A. Shop Primer Touchup and Repair: Clean field welds, bolted connections and abraded areas of shop paint.
   1. Paint exposed areas with same material used for shop painting.
   2. Apply by brush or spray to provide a minimum 2.0 mil dry film thickness.

B. Restore finishes damaged during installation and construction period. Return items that cannot be refinished in the field to manufacturer or fabricator. Refinish entire unit or provide new units.
C. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.

D. Remove temporary coverings and protection of adjacent work areas.

E. Clean installed products in accordance with manufacturer's instructions.

3.06 PROTECTION

A. Protect installed products from damage during construction.

END OF SECTION 05.75.00
SECTION 06.10.00

LUMBER AND ROUGH CARPENTRY

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: All wood framing, blocking and nailers, nails, bolts, screws, framing anchors and other rough hardware, and all other items needed for rough and finished carpentry in this work but not specifically described in other sections of these specifications.

1.02 QUALITY ASSURANCE

A. Standards: In addition to complying with all pertinent Codes and Regulations, all materials of this section shall comply with the pertinent provisions of:


4. Other: Similar and pertinent reference Standards for the products needed.


B. Conflicting Requirements: In the event of conflict between pertinent Codes and Regulations and the requirements of the referenced standards or these specifications, the more stringent provisions shall govern.

1.03 SUBMITTALS

A. Make all requests for substitution in strict accordance with the provisions.

1.04 PRODUCT HANDLING

A. Protection:

1. Use all means necessary to protect the materials of this section before, during and after delivery to the job site, and to protect the installed work and materials of all other trades.

2. Deliver the materials to the job site and store, in a safe area, out of the way of traffic and shored up off the ground surface.

3. Identify all framing lumber as to grades and store all grades separately from other grades.
4. Protect all metal products with adequate waterproof outer wrappings.

5. Use extreme care in the off loading of lumber to prevent damage, splitting, and breaking of materials.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Designer and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 GRADE STAMPS

A. Framing Lumber: Identify all framing lumber by the grade stamp of the Southern Pine Inspection Bureau or such other grade stamp as is approved in advance by the Designer.

B. Plywood: Identify all plywood as to species, grade, and glue type by the stamp of the American Plywood Association.

C. All concealed wood framing or blocking members in roofs and similar areas such as framing for wood supporting certain raised curbs for exhaust fans and edge blocking are to be pressure treated members and are to be designated as such.

D. Other: Identify all other materials of this section by the appropriate stamp of the agency listed in the reference standards, or by such other means as are approved in advance by the Designer.

2.02 MATERIALS

A. All materials of this section, unless specifically otherwise approved in advance by the Designer, shall meet or exceed the following:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal Framing Members; Nailers, Curbs, Blocking:</td>
<td>Southern Yellow Pine No. 2.</td>
</tr>
<tr>
<td>Steel Hardware:</td>
<td>ASTM A-7 or A-36 (Use galvanized at all Exterior Locations).</td>
</tr>
<tr>
<td>Nails:</td>
<td>Common (except as noted), Federal Specification FF-N-1-1 (Use Galvanized at all Exterior Locations).</td>
</tr>
<tr>
<td>Plywood:</td>
<td>Structural II, C-C, Exterior or Standard Sheathing Grade with exterior glue. APA Rated.</td>
</tr>
<tr>
<td>Pressure Treated Wood:</td>
<td>ACQ Preservative for above ground in contact with masonry or exposed to elements. 0.25 lb./cu. ft. minimum preservative retention.</td>
</tr>
</tbody>
</table>

100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
Wall Studs: 2” x 4” Spruce Pine Fir or better No. 1 Grade, typically nail with 16d nails.

Roof Framing: Southern Pine #2 minimum or Douglas Fir #2 minimum.

2.03 OTHER MATERIALS

A. All other materials, not specifically described but required for a complete and proper installation as indicated on the drawings, shall be new, suitable for the intended use, and subject to the approval of the Designer.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Inspection:

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that rough carpentry may be performed in strict accordance with the original design and all pertinent Codes and Regulations.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Designer.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 WORKMANSHIP

A. General: All rough carpentry shall produce joints true, tight, and well nailed with all members assembled in accordance with the drawings and with all pertinent Codes and Regulations.

B. Selection of Lumber Pieces:

1. Carefully Select All Members: Select individual pieces so that knots and obvious defects will not interfere with placing bolts or proper nailing or making proper connections.

2. Cut out and discard all defects which will render a piece unable to serve its intended function. Lumber will be rejected by the Designer, whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus, or mold, as well as for improper cutting and fitting.

C. Shimming: Do not shim any framing component.
3.03 GENERAL FRAMING

A. General:

1. In addition to all framing operations normal to the fabrication and erection indicated on the drawings, install all wood blocking required for the work of other trades. (As per project, coordinate with Roofing Contractor who furnishes new deck and blocking.)

2. Set all horizontal and sloped members with crown up.

3. Do not notch, bore, or cut members for pipes, ducts, conduits, or other reasons except as shown on the drawings or as specifically approved in advance by the Designer.

B. Exterior Work:

1. Primary work is wood used for framing, blocking and nailers required.

2. Install work accurately, level edges, without warping or splitting. Anchor wood to masonry with 1/2" x 12" anchor bolts at 4'-0" or use with power actuated fasteners.

C. Bearings:

1. Make all bearings full unless otherwise indicated on the drawings.

2. Finish all bearings surfaces on which structural members are to rest so as to give sure and even support. Where framing members slope, cut or notch the ends as required to give uniform bearing surface.

3.04 BLOCKING

A. Blocking: Install all blocking required to support all items of finish and to cut off all concealed draft openings, both vertical and horizontal, between ceiling and occupied spaces.

3.05 ALIGNMENTS

On all framing members to receive a finished surface, align the finish subsurface to vary not more than 1/8" from the plane of surfaces of adjacent framing and furring members.

3.06 FASTENING

A. Nailing:

1. Use only common wire nails or spikes of the dimension shown on the Nailing Schedule, except where otherwise specifically noted on the drawings.

2. For conditions not covered in the Nailing Schedule, provide penetration into the piece receiving the point of not less than 1/2 the length of the nail or spike, provided, however, that 16d nails shall be used to connect two pieces of two inch (nominal) thickness.

3. Do all nailing without splitting wood. Pre-bore as required. Replace all split members,
B. Bolting:

1. Drill holes 1/16" larger in diameter than the bolts being used. Drill straight and true from one side only.

2. Bolt threads shall not bear on wood. Use washers under head and nut where both bear on wood. Use washers under all nuts.

C. Screws:

1. For lag screws and wood screws, pre-bore holes same diameter as root of threads; enlarge holes to shank diameter for length of shank.

2. Screw, do not drive, all lag screws and wood screws.

D. Fastening of Pressure Treated Lumber:

1. All fasteners used in pressure treated lumber shall be hot dip galvanized.

2. Fasteners shall meet ASTM A-153 specification for hot dipped galvanizing.

3.07 NAILING SCHEDULE

Perform all nailing in strict accordance with "Nailing Schedule" in the applicable edition of the Standard Building Code.

END OF SECTION 06.10.00
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Finish carpentry items.
   B. Hardware and attachment accessories.

1.02 RELATED REQUIREMENTS
   A. Section 06.10.00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
   B. Section 06.42.16 - Wood-Veneer Paneling: Shop fabricated custom paneling.
   C. Section 08.43.13 - Aluminum Storefront: Synthetic Marble sills.

1.03 REFERENCE STANDARDS
   B. ANSI A135.4 - American National Standard for Basic Hardboard; 2012.
   G. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
   J. BHMA A156.9 - American National Standard for Cabinet Hardware; 2010.
   L. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
   M. PS 1 - Structural Plywood; 2009.

1.04 SUBMITTALS
   A. Product Data:
      1. Provide data on fire retardant treatment materials and application instructions.
      2. Provide instructions for attachment hardware and finish hardware.
   B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
      1. Provide the information required by AWI/AWMAC/WI (AWS).

1.05 QUALITY ASSURANCE
   A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
      1. Company with at least one project within the past 5 years with value of woodwork within 20 percent of cost of woodwork for this project.
      2. Single Source Responsibility: Provide and install this work from single fabricator.
1.06 DELIVERY, STORAGE, AND HANDLING
   A. Protect work from moisture damage.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS
   A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
   B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.
   C. Exterior Woodwork Items:
      1. Enclosing Soffit Spaces: As detailed.
   D. Interior Woodwork Items:
      1. Moldings, Bases, Casings, and Miscellaneous Trim: Clear white pine; prepare for paint finish.
      2. Stairs, Balustrades, and Handrails: Clear fir; prepare for stained finish.
      3. Loose Shelving: Birch plywood; prepare for paint finish.

2.02 WOOD-BASED COMPONENTS
   A. Wood fabricated from old growth timber is not permitted.
   B. Wood fabricated from timber recovered from riverbeds or otherwise abandoned is permitted, unless indicated otherwise, and provided it is clean and free of contamination, identify source; provide lumber re-graded by an inspection service accredited by the American Lumber Standard Committee, Inc. (ALSC).

2.03 LUMBER MATERIALS
   A. Hardwood Lumber: To be selected species, quarter sawn, maximum moisture content of 6 percent; with vertical grain, of quality suitable for transparent finish.

2.04 SHEET MATERIALS
   A. Softwood Plywood, Not Exposed to View: Any face species, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.
   B. Softwood Plywood Exposed to View: Face species as indicated, rotary cut, medium density fiberboard core; PS 1 Grade A-B; glue type as recommended for application.
   C. Hardwood Plywood: Face species as indicated, rotary cut, book matched, medium density fiberboard core; HPVA HP-1, Front Face Grade AA, Back Face Grade 1; glue type as recommended for application.
   D. Particleboard: ANSI A208.1; Composed of wood chips, sawdust, or flakes of medium density, made with waterproof resin binders; of grade to suit application; sanded faces.
   E. Hardboard: ANSI A135.4; Pressed wood fiber with resin binder, Class 1 - Tempered, 1/4 inch thick, smooth one side (S1S).

2.05 PLASTIC LAMINATE MATERIALS
   A. Plastic Laminate: NEMA LD 3, HGS; color as selected; textured, low gloss finish.
   B. Low Pressure Laminate: Melamine; selected color, and furniture surface texture.

2.06 FASTENINGS
   A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.
B. Concealed Joint Fasteners: Threaded steel.

2.07 ACCESSORIES
A. Lumber for Shimming and Blocking: Softwood lumber of Douglas Fir species.
B. Cellular PVC Trim: Extruded, expanded PVC; UV-resistant, heat-stabilized, and rigid material.
   1. Density: 31 pounds per cubic foot, minimum.
   2. Flame Spread: ASTM E84, 75, maximum.
C. Plain Glass: ASTM C1036 annealed float glass, clear, 6 mm thick minimum.
D. Safety Glass: Laminated glass complying with 16 CFR 1201 and ANSI Z97.1; clear; nominally 6 mm thick.
E. Wood Filler: Solvent base, tinted to match surface finish color.

2.08 HARDWARE
A. Hardware: Comply with BHMA A156.9.

2.09 WOOD TREATMENT
A. Factory-Treated Lumber: Comply with requirements of AWPA U1 - Use Category System for pressure impregnated wood treatments determined by use categories, expected service conditions, and specific applications.
B. Fire Retardant Treatment (FR-S Type): Chemically treated and pressure impregnated; capable of providing flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
C. Wood Preservative by Pressure Treatment (PT Type): Provide AWPA U1 treatment using waterborne preservative with 0.25 percent retention.
D. Wood Preservative (Surface Application): Clear, ______________ type, _______ manufactured by ____________.
E. Shop pressure treat wood materials requiring fire rating to concealed wood blocking.
F. Provide identification on fire retardant treated material.
G. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.
H. Redry wood after pressure treatment to maximum 15 percent moisture content.

2.10 FABRICATION
A. Shop assemble work for delivery to site, permitting passage through building openings.
B. Cap exposed plastic laminate finish edges with material of same finish and pattern.
C. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
D. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

2.11 SHOP FINISHING
A. Sand work smooth and set exposed nails and screws.
B. Apply wood filler in exposed nail and screw indentations.
C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.
D. Finish work in accordance with AWI/AWMAC/WI (AWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. System - 12, Polyurethane, Water-based.
      b. Stain: As selected by Architect.
      c. Sheen: Satin.
   2. Opaque:
      a. System - 12, Polyurethane, Water-based.
      b. Color: As selected by Architect.
      c. Sheen: Satin.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify adequacy of backing and support framing.
   B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION
   A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
   B. Set and secure materials and components in place, plumb and level.
   C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

3.03 SITE APPLIED WOOD TREATMENT
   A. No site finishing on any stained items will be allowed.

3.04 TOLERANCES
   A. Maximum Variation from True Position: 1/16 inch.
   B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION 06.20.00
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Specially fabricated cabinet units.
   B. Cabinet hardware.
   C. Preparation for installing utilities.

1.02 RELATED REQUIREMENTS
   A. Section 08.80.00 - Glazing: Glass for casework.

1.03 REFERENCE STANDARDS
   A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
   D. BHMA A156.9 - American National Standard for Cabinet Hardware; 2010.
   E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
   F. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
   G. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
   H. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.9).
   I. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS
   A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS
   A. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
      1. Provide the information required by AWI/AWMAC/WI (AWS).
      2. Include certification program label.
   B. Product Data: Provide data for hardware accessories.
   C. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet and shelf unit substrate and finish.
   D. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

1.06 QUALITY ASSURANCE
   A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
      1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

B. Quality Certification: Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
   1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) requirements for grade or grades specified.
   2. Provide designated labels on shop drawings as required by certification program.
   3. Provide designated labels on installed products as required by certification program.
   4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
   5. Replace, repair, or rework all work for which certification is refused.

1.07 MOCK-UP
   A. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware, finishes, and plumbing accessories.
   B. Locate where directed.
   C. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING
   A. Protect units from moisture damage.

1.09 FIELD CONDITIONS
   A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS
   A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
   B. Wood Veneer Faced Cabinet:
      2. Semi-Exposed Surfaces: HPVA Grade A, To be Determined, quarter cut, slip-matched.
   C. Plastic Laminate Faced Cabinets: Custom grade.
   D. Breakroom Cabinets: Plastic laminate faced, Custom grade.

2.02 WOOD-BASED COMPONENTS
   A. Wood fabricated from old growth timber is not permitted.

2.03 LAMINATE MATERIALS
   A. Thermally Fused Laminate (TFL): NEMA LD 3, Type VGL laminate panels.
   B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

2.04 ACCESSORIES
   A. Adhesive: Type recommended by fabricator to suit application.
   B. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
1. Color: As selected by Architect from manufacturer's standard range.
2. Use at all exposed plywood edges.
3. Use at all exposed shelf edges.
C. Fasteners: Size and type to suit application.
D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
E. Concealed Joint Fasteners: Threaded steel.
F. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.

2.05 HARDWARE
A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, satin chrome finish, for nominal 1 inch spacing adjustments.
C. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers.
D. Drawer Slides:
   1. Static Load Capacity: Commercial grade.
E. Hinges: European style concealed self-closing type, steel with polished finish.

2.06 SHOP TREATMENT OF WOOD MATERIALS
A. Provide UL (DIR) listed and approved identification on fire retardant treated material.
B. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.

2.07 SITE FINISHING MATERIALS
A. Site finishing of stained materials will not be allowed.

2.08 FABRICATION
A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
   1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
   2. Cap exposed plastic laminate finish edges with material of same finish and pattern.
E. Matching Wood Grain: Comply with requirements of quality standard for specified Grade and as follows:
   1. Provide center matched panels at each elevation.
   2. Carry figure of cabinet fronts to toe kicks.
F. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches on center.

G. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

2.09 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.

C. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. System - 12, Polyurethane, Water-based.
      b. Stain: As selected by Architect.
      c. Sheen: Satin.
   2. Opaque:
      a. System - 12, Polyurethane, Water-based.
      b. Color: As selected by Architect.
      c. Sheen: Satin.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

C. Use fixture attachments in concealed locations for wall mounted components.

D. Use concealed joint fasteners to align and secure adjoining cabinet units.

E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

F. Secure cabinets to floor using appropriate angles and anchorages.

G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

H. Site glaze glass materials using the Interior Dry method specified in Section 08.80.00.

3.03 ADJUSTING

A. Adjust installed work.

B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION 06.41.00
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Bituminous dampproofing.
   B. Protection boards.
   C. Drainage panels.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. Product Data: Provide properties of primer, bitumen, and mastics.
   B. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.05 FIELD CONDITIONS
   A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until dampproofing has cured.

PART 2 PRODUCTS

2.01 DAMPPROOFING PRODUCTS
   A. Bituminous Dampproofing: Cold-applied water-based emulsion; asphalt with mineral colloid or chemical emulsifying agent; with or without fiber reinforcement; asbestos-free; suitable for application on vertical and horizontal surfaces.
      1. Composition - Vertical Application: ASTM D1227 Type III or ASTM D1187/D1187M Type I.
      2. Composition - Horizontal and Low-Slope Application: ASTM D1227 Type II or III.
      3. VOC Content: Not more than permitted by local, State, and federal regulations.
   B. Primers, Mastics, and Related Materials: Type as recommended by dampproofing manufacturer.

2.02 HOT ASPHALTIC MATERIALS
   A. Bitumen: ASTM D449/D449M, Type I, asphalt.
C. Sealing Mastic: Asphalt roof cement, ASTM D2822, Type I.

2.03 COLD ASPHALTIC MATERIALS
A. Asphalt Primer: ASTM D41/D41M, compatible with substrate.
B. Sealing Mastic: Asphalt roof cement, ASTM D2822, Type I.

2.04 ACCESSORIES
A. Drainage Panel: 1/4 inch thick formed plastic, hollowed sandwich.
B. Protection Board: 1/8 inch thick biodegradable hardboard.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify existing conditions before starting work.
B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.
C. Verify that items that penetrate surfaces to receive dampproofing are securely installed.

3.02 PREPARATION
A. Protect adjacent surfaces not designated to receive dampproofing.
B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.
C. Do not apply dampproofing to surfaces unacceptable to manufacturer.
D. Apply mastic to seal penetrations, small cracks, or minor honeycomb in substrate.

3.03 APPLICATION
A. Foundation Walls: Apply two coats of asphalt dampproofing.
B. Perform work in accordance with NRCA ML104.
C. Prime surfaces in accordance with manufacturer's instructions.
D. Apply bitumen with mop.
E. Apply bitumen at a temperature limited by equiviscous temperature (EVT) plus or minus 25 F; do not exceed finish blowing temperature for four hours.
F. Apply bitumen in two coats, continuous and uniform, at a rate of 25 sq ft/gal per coat.
G. Apply from 2 inches below finish grade elevation down to top of footings.
H. Seal items projecting through dampproofing surface with mastic. Seal watertight.
I. Place drainage panel directly over dampproofing, butt joints, place to encourage drainage downward.
J. Place protection board over drainage panel, butt joints, and adhere with mastic.
K. Scribe and cut boards around projections, penetrations, and interruptions.

END OF SECTION 07.11.13
SECTION 07.14.00
FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Fluid applied membrane waterproofing.
B. Above-grade waterproofing accessories.
C. Below-grade waterproofing accessories.

1.02 RELATED REQUIREMENTS
A. Section 03.30.00 - Cast-in-Place Concrete: Concrete substrate.
B. Section 04.20.00 - Unit Masonry: Masonry joints prepared to receive flashings.
C. Section 07.21.00 - Thermal Insulation: Insulation used for protective cover.
D. Section 07.62.00 - Sheet Metal Flashing and Trim: Metal parapet covers, copings, and counterflashings.
E. Section 07.92.00 - Joint Sealants: Sealing moving joints in waterproofed surfaces that are not part of work in this section.
F. Section 22.10.06 - Plumbing Piping Specialties: Roof drain and plumbing vent flashing flanges.

1.03 REFERENCE STANDARDS
E. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2013).

1.04 SUBMITTALS
A. Product Data: Provide data for membrane, surface conditioner, flexible flashings, joint cover sheet, and joint and crack sealants.
B. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
C. Certificate: Certify that products meet or exceed specified requirements.
D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and acceptable installation temperatures.
E. Warranty:
   1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
   2. Submit installer's certification that installation complies with all warranty conditions for the waterproof membrane.

1.05 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacture of fluid-applied waterproofing membranes with three years experience.

100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
B. Installer Qualifications: Company specializing in installation of fluid-applied waterproofing with minimum five years experience.

C. Mock-Up: Construct a mock-up consisting of 100 sq ft of vertical waterproofed panel, including internal and external corners, drainage panel, base flashings, control joints, expansion joints, counterflashings, and protective cover similar to those that will be present in the finished work.
   1. Locate where directed.
   2. Mock-up may remain as part of the work.

1.06 FIELD CONDITIONS
A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until cured.

1.07 WARRANTY
A. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no cost to Owner.

B. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.01 MEMBRANE AND FLASHING MATERIALS
A. Cold-Applied Rubberized Asphalt/HDPE Composite Waterproofing: Water-based, capable of being applied to green concrete; spray-applied polymer modified asphalt membrane with HDPE core and drainage composite.
   1. Film Thickness: 157 mils (6 inch), minimum.
   2. Tensile Strength: 662 psi, minimum, when tested in accordance with ASTM D412.
   3. Ultimate Elongation: 4,140 percent, minimum, when tested in accordance with ASTM D412.
   4. Water Vapor Permeance: 0.21 perm, maximum, when tested in accordance with ASTM E96/E96M.
   5. Resistance to decay: 4 percent permanent loss, maximum, when tested in accordance with ASTM E154/E154M, Section 13.
   6. Adhesion to Concrete and Masonry: 11 pounds-force per inch, when tested in accordance with ASTM C836/C836M.
   7. Adhesion to HDPE: 28.36 pounds-force per inch, minimum, when tested in accordance with ASTM C836/C836M.
   8. Adhesion to Polypropylene Fabric: 31.19 pounds-force per inch, minimum, when tested in accordance with ASTM C836/C836M.

B. Under-Tile Waterproofing and Anti-Fracture Membrane: Specifically designed for bonding to concrete, backer boards, and plywood under ceramic tile; complying with ANSI A118.10.
   1. Material: Fluid-applied water-based SBS rubber membrane, 40 mils thick, minimum, with polyester fabric reinforcing at edges, corners, joints, and cracks.
   2. ICC-ES approved.

C. Flexible Flashings: Type recommended by membrane manufacturer.

D. Joint Cover Sheet: 1 inch thick elastic sheet material designated for and compatible with membrane.

2.02 ACCESSORIES
A. Sealant for Joints and Cracks in Substrate: Type compatible with waterproofing material and as recommended by waterproofing manufacturer.

B. Separation Sheet: Sheet polyethylene, 6 mil thick.
C. Protection Board: Rigid insulation specified in Section 07.21.00.

D. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.

E. Cant Strips: Premolded composition material.

F. Counterflashings: stainless type, 0.01 inches thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.

C. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.

D. Verify that items that penetrate surfaces to receive waterproofing are securely installed.

3.02 PREPARATION

A. Protect adjacent surfaces not designated to receive waterproofing.

B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions. Vacuum substrate clean.

C. Do not apply waterproofing to surfaces unacceptable to manufacturer.

D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.

E. Seal moving joints and joints with sealant, not rigid filler, using procedures recommended by sealant and waterproofing manufacturers.

F. Install cant strips at inside corners.

3.03 INSTALLATION

A. Apply waterproofing in accordance with manufacturer's instructions to specified minimum thickness.

B. Apply primer or surface conditioner at a rate recommended by manufacturer. Protect conditioner from rain or frost until dry.

C. At joints and cracks less than 1/2 inch in width including joints between horizontal and vertical surfaces, apply 12 inch wide strip of joint cover sheet.

D. At joints from 1/2 to 1 inch in width, loop joint cover sheet down into joint between 1-1/4 and 1/-3/4 inch. Extend sheet 6 inches on either side of expansion joint.

E. Center joint cover sheet over joints. Roll sheet into 1/8 inch coating of waterproofing material. Apply second coat over sheet extending minimum of 6 inches beyond sheet edges.

F. Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 6 inches above horizontal surface for first ply and 10 inches at subsequent plies laid in shingle fashion.

G. Apply extra thickness of waterproofing material at corners, intersections, and angles.

H. Install flexible flashings and seal into waterproofing material. Seal items penetrating through membrane with flexible flashings.

I. Extend waterproofing material and flexible flashing into drain clamp flange, apply adequate coating of liquid membrane to assure clamp ring seal. Coordinate with drain installation in Section 22.10.06.

J. Seal membrane and flashings to adjoining surfaces. Install termination bar at all edges. Install counterflashing over all exposed edges.
3.04 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

A. After membrane has cooled, but before it becomes dusty, apply separation sheet. Lap joints to ensure complete coverage.

B. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward. Scribe and cut boards around projections, penetrations, and interruptions.

C. Place protection board directly against drainage panel; butt joints. Scribe and cut boards around projections, penetrations, and interruptions.

D. Adhere protection board to substrate with compatible adhesive.

3.05 FIELD QUALITY CONTROL

A. On completion of horizontal membrane installation, dam installation area in preparation for flood testing.

B. Flood to minimum depth of 1 inch with clean water. After 48 hours, inspect for leaks.

C. If leaking is found, remove water, repair leaking areas with new waterproofing materials as directed by Architect; repeat flood test. Repair damage to building.

D. When area is proven watertight, drain water and remove dam.

3.06 PROTECTION

A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION 07.14.00
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Board insulation and integral vapor retarder at cavity wall construction, perimeter foundation wall, underside of floor slabs, over roof deck, over roof sheathing, and exterior wall behind ________ wall finish.
   B. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.
   C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
   B. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.
   C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
   D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
   E. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
   F. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.05 QUALITY ASSURANCE
   A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/sle:
      1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.
      2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.
1.06 FIELD CONDITIONS
A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 FOAM BOARD INSULATION MATERIALS
A. Extruded Polystyrene Board Insulation: Extruded polystyrene board; ASTM C578; with either natural skin or cut cell surfaces, and the following characteristics:
   1. Type: ASTM C578.
   2. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   3. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
   4. R-value; 1 inch of material at 72 degrees F: 5, minimum.
   5. Complies with fire resistance requirements shown on the drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
   7. Water Absorption, Maximum: 0.3 percent, by volume.
B. Polyisocyanurate Board Insulation with Facers Both Sides: Rigid cellular foam, complying with ASTM C1289; Type I, aluminum foil both faces; Class 2, glass fiber-reinforced core.
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
   3. Complies with fire resistance requirements shown on the drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
   4. Compressive Strength: 25 psi
   5. Board Size: 48 by 96 inch.

2.02 BATT INSULATION MATERIALS
A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
   1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
   3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
C. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
   1. Where indicated, provide foil facing on one side; with flame spread index of 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.

2.03 ACCESSORIES
A. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.
B. Insulation Fasteners: Lengths of unfinished, 13 gage (0.072 inch) high carbon spring steel with chisel or mitered tips, held in place by tension, length to suit insulation thickness and substrate, capable of securely supporting insulation in place.
C. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

D. Nails or Staples: Steel wire; electroplated or galvanized; type and size to suit application.

E. Wire Mesh: Galvanized steel, hexagonal wire mesh.

F. Protection Board for Below Grade Insulation: Wood fiberboard, 1/4 inch thick.

G. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Install boards horizontally on foundation perimeter.
   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and to protrusions.

B. Extend boards over expansion joints, unbonded to foundation on one side of joint.

C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

D. Immediately following application of board insulation, place protective boards over exposed insulation surfaces.
   1. Install boards horizontally from base of foundation to top of insulation.
   2. Butt boards tightly, with joints staggered from insulation joints.

3.03 BOARD INSTALLATION AT EXTERIOR WALLS

A. Adhere a 6 inch wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
   1. Tape seal joints between sheets.
   2. Extend sheet full height of joint.

B. Install rigid insulation directly to steel studs or exterior grade sheathing at 16 inches on center with manufacturer recommended mechanical fasteners. Tape all joints with manufacturer's minimum 4 inch wide sealant tape; comply with ASTM E2357.

C. Install boards horizontally on walls.
   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and to protrusions.

D. Extend boards over expansion joints, unbonded to wall on one side of joint.

E. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

F. Place 6 inch wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames. Tape seal in place to ensure continuity of vapor retarder and air seal.

G. Tape insulation board joints.
3.04 BOARD INSTALLATION AT CAVITY WALLS
   A. Install boards to fit snugly between wall ties.
      1. Place membrane surface against adhesive.
      2. Place membrane surface facing out, and tape seal board joints.
   B. Install boards horizontally on walls.
      1. Place boards to maximize adhesive contact.
      2. Install in running bond pattern.
      3. Butt edges and ends tightly to adjacent boards and to protrusions.
      4. Place impale fastener locking discs.
   C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
   D. Place 6 inch wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames. Tape seal in place to ensure continuity of vapor retarder and air seal.

3.05 BOARD INSTALLATION UNDER CONCRETE SLABS
   A. Place insulation under slabs on grade after base for slab has been compacted.
   B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
   C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.06 BOARD INSTALLATION OVER LOW SLOPE ROOF DECK
   A. Board Installation Over Roof Deck, General:
      1. See applicable roofing specification section for specific board installation requirements.
      2. Ensure vapor retarder is clean and dry, continuous, and ready for application of roofing system.
      3. Fasten insulation to deck in accordance with roofing manufacturer's written instructions and applicable Factory Mutual requirements.
      4. Do not apply more insulation than can be covered with roofing in same day.

3.07 FIELD QUALITY CONTROL
   A. Coordination of ABAA Tests and Inspections:
      1. Provide testing and inspection required by ABAA QAP.
      2. Notify in ABAA writing of schedule for air barrier work. Allow adequate time for testing and inspection.
      3. Cooperate with ABAA testing agency.
      4. Allow access to air barrier work areas and staging.
      5. Do not cover air barrier work until tested, inspected, and accepted.

3.08 PROTECTION
   A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 07.21.00
FOAMED-IN-PLACE INSULATION

PART 1 GENERAL -- NOT USED

1.01 SECTION INCLUDES

A. Foamed-in-place insulation.
   1. In exterior framed walls.
   2. In exterior wall crevices.
   3. At junctions of dissimilar wall and roof materials.

B. Protective intumescent coating.

1.02 REFERENCE STANDARDS


1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work of this section.

1.04 SUBMITTALS

A. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.
B. Certificates: Certify that products of this section meet or exceed specified requirements.
C. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.
D. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.
E. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
F. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.
B. Applicator Qualifications: Company specializing in performing work of the type specified, with minimum three years documented experience.
C. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/sle:

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ISSUED: 3/13/2017
1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.
2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.06 FIELD CONDITIONS
A. Do not install insulation when ambient temperature is lower than 70 degrees F.
B. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.
C. Do not apply foam when temperature is within 5 degrees F of dew point.

PART 2 PRODUCTS

2.01 MATERIALS
A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
   1. Regulatory Requirements: Conform to applicable code for flame and smoke limitations.
   2. Aged Thermal Resistance: R-value of 5 (deg F hr sq ft)/Btu, minimum, when tested at 1 inch thickness in accordance with ASTM C518 after aging for 180 days at 41 degrees F.
   3. Water Vapor Permeance: Vapor retarder; 2 perm, maximum, when tested at intended thickness in accordance with ASTM E96/E96M, desiccant method.
   4. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
   5. Air Permeance: 0.004 cfm/sq ft, maximum, when tested at intended thickness in accordance with ASTM E2178 or ASTM E283 at 1.5 psf.
   6. Closed Cell Content: At least 90 percent.
   7. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.

2.02 ACCESSORIES
A. Primer: As required by insulation manufacturer.
B. Overcoat: Intumescent coating of type recommended by insulation manufacturer and as required to comply with applicable codes.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify work within construction spaces or crevices is complete prior to insulation application.
B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat adhesion.

3.02 PREPARATION
A. Mask and protect adjacent surfaces from over spray or dusting.
B. Apply primer in accordance with manufacturer's instructions.

3.03 APPLICATION
A. Apply insulation in accordance with manufacturer's instructions.
B. Apply insulation by spray method, to a uniform monolithic density without voids.
C. Apply overcoat monolithically, without voids to fully cover foam insulation, to achieve fire rating required.
D. Patch damaged areas.
E. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.
F. Trim excess away for applied trim or remove as required for continuous sealant bead.

3.04 FIELD QUALITY CONTROL
A. Coordination of ABAA Tests and Inspections:
   1. Provide testing and inspection required by ABAA QAP.
   2. Notify in ABAA writing of schedule for air barrier work. Allow adequate time for testing and inspection.
   3. Cooperate with ABAA testing agency.
   4. Allow access to air barrier work areas and staging.
   5. Do not cover air barrier work until tested, inspected, and accepted.

3.05 PROTECTION
A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION 07.21.19
SECTION 07.24.00
EXTERIOR INSULATION AND FINISH SYSTEMS

PART 1 GENERAL -- NOT USED

1.01 SECTION INCLUDES
A. Composite wall and soffit cladding of rigid insulation and reinforced finish coating over cementitious base coat ("Class PM").
B. Drainage and water-resistant barriers behind insulation board.
C. Incidental uses of same finish coating applied directly to concrete and masonry.

1.02 RELATED REQUIREMENTS
A. Section 05.40.00 - Cold-Formed Metal Framing: Sheathing on metal studs.
B. Section 06.10.00 - Rough Carpentry: Sheathing on wood framing.
C. Section 07.62.00 - Sheet Metal Flashing and Trim: Perimeter flashings.
D. Section 07.92.00 - Joint Sealants: Sealing joints between EIFS and adjacent construction and penetrations through EIFS.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on system materials, product characteristics, performance criteria, and system limitations.
C. Shop Drawings: Indicate wall and soffit joint patterns, joint details, and molding profiles.
D. Selection Samples: Submit manufacturer's standard range of samples illustrating available coating colors and textures.
E. Verification Samples: Submit actual samples of selected coating on specified substrate, minimum 12 inches square, illustrating project colors and textures.
F. Manufacturer's Installation Instructions: Indicate preparation required, installation techniques, and jointing requirements.

1.05 QUALITY ASSURANCE
A. Maintain copy of specified installation standard and manufacturer's installation instructions at project site during installation.
B. EIFS Manufacturer Qualifications: Provide EIFS products other than insulation from the same manufacturer with qualifications as follows:
   1. Member in good standing of EIMA (EIFS Industry Members Association).
   2. Manufacturer of EIFS products for not less than 5 years.
C. Insulation Manufacturer Qualifications: Approved by manufacturer of EIFS and approved and labeled under third party quality program as required by applicable building code.
D. Installer Qualifications: Company specializing in the type of work specified and with at least three years of documented experience.

1.06 MOCK-UP
A. Construct mock-up of typical EIFS application on specified substrate, size as required to include examples of all key conditions, and including flashings, joints, and edge conditions.
B. Locate mock-up at approved location convenient for comparison to finished work.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Delivery: Deliver materials to project site in manufacturer's original, unopened containers with labels intact. Inspect materials and notify manufacturer of any discrepancies.
B. Storage: Store materials as directed by manufacturer's written instructions.
   1. Protect adhesives and finish materials from freezing, temperatures below 40 degrees F and temperatures in excess of 90 degrees F.
   2. Protect Portland cement based materials from moisture and humidity. Store under cover off the ground in a dry location.
   3. Protect insulation materials from exposure to sunlight.

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1.08 FIELD CONDITIONS

A. Do not prepare materials or apply EIFS under conditions other than those described in the manufacturer's written instructions.

B. Do not prepare materials or apply EIFS during inclement weather unless areas of installation are protected. Protect installed EIFS areas from inclement weather until dry.

C. Do not install coatings or sealants when ambient temperature is below 40 degrees F.

D. Do not leave installed insulation board exposed to sunlight for extended periods of time.

1.09 WARRANTY

A. See Section 01.78.21 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's standard material warranty, covering a period of not less than 10 years.

C. Provide separate warranty from installer covering labor for repairs or replacement for a period of not less than 10 years.

PART 2 PRODUCTS

2.01 EXTERIOR INSULATION AND FINISH SYSTEM

A. Exterior Insulation and Finish System: DRAINAGE type; reinforced finish coating on insulation board with drainage grooves adhesive-applied to water-resistive coating over substrate; provide a complete system that has been tested to show compliance with the following characteristics; include all components of specified system and substrate(s) in tested samples.

B. Fire Characteristics:
   1. Flammability: Pass, when tested in accordance with NFPA 285.
   2. Ignitibility: No sustained flaming when tested in accordance with NFPA 268.
   3. Potential Heat of Foam Plastic Insulation Tested Independently of Assembly: No portion of the assembly having potential heat that exceeds that of the insulation sample tested for flammability (above), when tested in accordance with NFPA 259 with results expressed in Btu per square foot.

C. Water Penetration Resistance: No water penetration beyond the plane of the base coat/insulation board interface after 15 minutes, when tested in accordance with ASTM E331 at 6.24 psf differential pressure with tracer dye in the water spray; include in tested sample at least two vertical joints and one horizontal joint of same type to be used in construction; disassemble sample if necessary to determine extent of water penetration.

D. Drainage Efficiency: Average minimum efficiency of 90 percent, when tested in accordance with ASTM E2273 for 75 minutes.

E. Salt Spray Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 300 hours exposure in accordance with ASTM B117, using at least three samples matching intended assembly, at least 4 by 6 inches in size.

F. Freeze-Thaw Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 10 cycles, when tested in accordance with ICC-ES AC219 or ICC-ES AC235.

G. Weathering Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 2000 hours of accelerated weathering conducted in accordance with ASTM G153 Cycle 1 or ASTM G155 Cycle 1, 5, or 9.

H. Water Degradation Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 14 days exposure, when tested in accordance with ASTM D2247.
I. Mildew Resistance: No growth supported on finish coating during 28 day exposure period, when tested in accordance with ASTM D3273.

J. Abrasion Resistance Of Finish: No cracking, checking or loss of film integrity when tested in accordance with ASTM D968 with 113.5 gallons of sand.

2.02 MATERIALS

A. Finish Coating Top Coat: Water-based, air curing, acrylic or polymer-based finish with integral color and texture.

B. Base Coat: Acrylic- or polymer-modified, fiber reinforced Portland cement coating.
   1. Portland Cement: ASTM C150/C150M, Type I or II.
   2. Base Coat Thickness: 1/4 inch, minimum.

C. Reinforcing Mesh: Balanced, open weave glass fiber fabric, treated for compatibility and improved bond with coating, weight, strength, and number of layers as required to meet required system impact rating.

D. Insulation Board: Extruded polystyrene (XPS) board insulation with natural skin surfaces; ASTM C578, Type V, with the following characteristics:
   1. Board Thickness: As indicated on drawings.
   2. Thermal Resistance: R-value of 5.0 per 1 inch at 75 degrees F mean temperature using ASTM C177 test method.

E. Water-Resistive Barrier Coating: Fluid-applied air and water barrier membrane; applied to sheathing; furnished or approved by EIFS manufacturer.

2.03 ACCESSORY MATERIALS

A. Insulation Adhesive: Type required by EIFS manufacturer for project substrate.

B. Insulation Fasteners: Fastener and plate system appropriate for substrate and as recommended by EIFS manufacturer.

C. Trim: EIFS manufacturer's standard galvanized steel trim accessories, as required for a complete project and including starter track and drainage accessories.

D. Sealant Materials: Compatible with EIFS materials and as recommended by EIFS manufacturer.

PART 3 EXECUTION

3.01 GENERAL

A. Install in accordance with EIFS manufacturer's instructions and ASTM C1397.

B. Where different requirements appear in either document, comply with the most stringent.

C. Neither of these documents supercedes the provisions of the Contract Documents that define the contractual relationships between the parties or the scope of work.

3.02 EXAMINATION

A. Verify that substrate is sound and free of oil, dirt, other surface contaminants, efflorescence, loose materials, or protrusions that could interfere with EIFS installation and is of a type and construction that is acceptable to EIFS manufacturer. Do not begin work until substrate and adjacent materials are complete and thoroughly dry.

B. Verify that substrate surface is flat, with no deviation greater than 1/4 in when tested with a 10 ft straightedge.
3.03 PREPARATION
A. Install self-furring metal lath over solid substrates that are deemed unacceptable to receive adhesively applied insulation. Install in accordance with ASTM C1063, except for butt-lapping instead of overlapping.
   1. Attach to concrete and concrete masonry using corrosion-resistant power or powder actuated fasteners or hardened concrete stub nails not less than 3/4 inch long and with heads not less than 3/8 inch wide. Ensure that fasteners are securely attached to substrate and spaced at maximum 16 inches on center horizontally and 7 inches vertically.
B. Apply primer to substrate as recommended by EIFS manufacturer for project conditions.

3.04 INSTALLATION - WATER-RESISTIVE BARRIER
A. Apply barrier coating as recommended by coating manufacturer; prime substrate as required before application.
B. Seal substrate transitions and intersections with other materials to form continuous water-resistant barrier on exterior of sheathing, using method recommended by manufacturer.
C. At door and window rough openings and other wall penetrations, seal water-resistive barrier and flexible flashings to rough opening before installation of metal flashings, sills, or frames, using method recommended by manufacturer.
D. At moving expansion joints, apply flexible flashing or flashing tape across and recessed into joint with U-loop forming continuous barrier but allowing movement.
E. Lap flexible flashing or flashing tape at least 2 inches on each side of joint or transition.
F. Install drainage layer or spacers after flashing tape has been completed.
G. Exterior Soffit Vents: Install according to manufacturer's written instructions and in locations shown on the drawings. Provide vent area specified.

3.05 INSTALLATION - INSULATION
A. Install in accordance with manufacturer's instructions.
B. Prior to installation of boards, install starter track and other trim level and plumb and securely fastened. Install only in full lengths, to minimize moisture intrusion; cut horizontal trim tight to vertical trim.
C. Install back wrap reinforcing mesh at all openings and terminations that are not to be protected with trim.
D. On wall surfaces, install boards horizontally.
E. Place boards in a method to maximize tight joints. Stagger vertical joints and interlock at corners. Butt edges and ends tight to adjacent board and to protrusions. Achieve a continuous flush insulation surface, with no gaps in excess of 1/16 inch.
F. Fill gaps greater than 1/16 inch with strips or shims cut from the same insulation material.
G. Rasp irregularities off surface of installed insulation board.
H. Mechanical Fastening: Space fasteners as recommended by EIFS manufacturer.
I. Adhesive Attachment: Use method required by manufacturer to achieve drainage efficiency specified; do not close up drainage channels when placing insulation board.

3.06 INSTALLATION - CLASS PM FINISH
A. Joints: Install control and expansion joints at spacings indicated on the drawings. Do not exceed 150 sq ft for areas defined by the placement of control joints.
B. Reinforcing Mesh: Install in strict accordance with manufacturer's instructions, using mechanical fasteners at spacing recommended.
1. Lap reinforcing mesh edges and ends 2 inches minimum.

C. Base Coat: Install to minimum thickness specified, following manufacturer's instructions. Leave base coat in condition suitable to receive finish coat.

D. Finish Coat: Apply finish coat after base coat has dried not less than 24 hours, embed finish aggregate, and finish to a uniform texture and color.
   1. Thickness: As recommended by manufacturer.

E. Seal control and expansion joints within the field of exterior finish and insulation system, using procedures recommended by sealant and finish system manufacturers.

3.07 CLEANING
   A. Clean EIFS surfaces and work areas of foreign materials resulting from EIFS operations.

3.08 PROTECTION
   A. Protect completed work from damage and soiling by subsequent work.

END OF SECTION 07.24.00
PART 1  GENERAL

1.01  SECTION INCLUDES
A. Water-Resistive Barrier: Under exterior wall cladding, over sheathing or other substrate; not air tight or vapor retardant.
B. Vapor Retarders: Materials to make exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls water vapor resistant and air tight.
C. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

1.02  RELATED REQUIREMENTS
A. Section 03.30.00 - Cast-in-Place Concrete: Vapor retarder under concrete slabs on grade.
B. Section 07.24.00 - Exterior Insulation and Finish Systems: Water-resistive barrier under exterior insulation.

1.03  DEFINITIONS
A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
   Note: For the purposes of this specification, vapor permeable air barriers are classified as vapor retarders.
C. Vapor Retarder: Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
   1. Water Vapor Permeance: For purposes of conversion, 57.2 ng/(Pa s sq m) = 1 perm.
D. Water-Resistive Barrier: Water-shedding barrier made of material that is moisture resistant, to the degree specified, intended to be installed to shed water without sealed seams.

1.04  REFERENCE STANDARDS
E. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.

1.05  SUBMITTALS
A. Product Data: Provide data on material characteristics.
B. Shop Drawings: Provide drawings of special joint conditions.
C. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.
D. Manufacturer's Installation Instructions: Indicate preparation.
E. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

F. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.06 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/sle:
   1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.
   2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.07 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES

A. Water-Resistive Barrier: Provide on exterior walls under exterior cladding.

B. Air Barrier:
   1. On outside surface of sheathing of exterior walls use air barrier coating.

C. Interior Vapor Retarder:
   1. On inside face of studs of exterior walls, under cladding, use mechanically fastened vapor retarder sheet.

D. Exterior Vapor Retarder:
   1. On under side of elevated floors over enclosed soffit space use vapor retarder coating.

2.02 WATER-RESISTIVE BARRIER MATERIALS (NEITHER AIR BARRIER NOR VAPOR RETARDER)

A. Plastic Sheet: Polymeric-based sheet complying with requirements of ICC-ES AC38 Grade D with 60-minute water-resistance; do not use polyethylene sheet.

2.03 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

A. Air Barrier Sheet, Mechanically Fastened:
   1. Air Permeance: 0.004 cubic feet per minute per square foot, maximum, when tested in accordance with ASTM E2178.
   2. Water Vapor Permeance: 5 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure A (desiccant procedure).
   3. Water Penetration Resistance: Withstand a water head of 21 inches, minimum, for minimum of 5 hours, when tested in accordance with AATCC Test Method 127.
   4. Ultraviolet and Weathering Resistance: Approved in writing by manufacturer for minimum of 180 days weather exposure.
   5. Surface Burning Characteristics: Flame spread index of 25 or less, and smoke developed index of 50 or less, when tested in accordance with ASTM E84.
   6. Seam and Perimeter Tape: Polyethylene self adhering type, mesh reinforced, 2 inches wide, compatible with sheet material; unless otherwise specified.

B. Air Barrier Sheet, Self-Adhered:
1. Air Permeance: 0.004 cubic feet per minute per square foot, maximum, when tested in accordance with ASTM E2178.
2. Water Vapor Permeance: 10 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure A (desiccant procedure).
4. Ultraviolet and Weathering Resistance: Approved in writing by manufacturer for maximum of 150 days weather exposure.
5. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less (Class A), when tested in accordance with ASTM E84.
6. Seam and Perimeter Tape: As recommended by sheet manufacturer.

C. Air Barrier, Fluid Applied: Vapor permeable, elastomeric waterproofing.
   1. Air Barrier Coating:
      b. Dry Film Thickness (DFT): 6 mils (0.006 inch), minimum.
      c. Air Permeance: 0.004 cubic feet per minute per square foot, maximum, when tested in accordance with ASTM E2178.
      d. Water Vapor Permeance: 5 perms, minimum, when tested in accordance with ASTM E96/E96M, Procedure B.

2.04 VAPOR RETARDER MATERIALS (AIR BARRIER AND WATER-RESISTIVE)
   A. Vapor Retarder Sheet: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent, complying with ASTM E1745, Class A; stated by manufacturer as suitable for application indicated. Single ply polyethylene is prohibited.
      1. Water Vapor Permeance: 0.3 perm, maximum, when tested in accordance with ASTM E96/E96M.
      2. Seam and Perimeter Tape: Polyethylene self adhering type, mesh reinforced, 2 inches wide, compatible with sheet material.

2.05 ACCESSORIES
   A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.
   C. Pre-formed Transition Membrane: Semi-rigid silicone composition, tapered edges, tear resistant.
   D. Liquid Flashing: One part, fast curing, non-sag, elastomeric, gun grade, trowelable liquid flashing.
   E. Vapor Retarder Tape: Coated polyester film with acrylic adhesive backing; pressure sensitive.
   F. Thinners and Cleaners: As recommended by material manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that surfaces and conditions are ready to accept the work of this section.

3.02 PREPARATION
   A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
   B. Clean and prime substrate surfaces to receive adhesives in accordance with manufacturer's instructions.
3.03 INSTALLATION

A. Install materials in accordance with manufacturer’s instructions.

B. Water-Resistive Barriers: Install continuous barrier over surfaces indicated, with sheets lapped to shed water but with seams not sealed.

C. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

D. Vapor Retarders: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

E. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.

F. Mechanically Fastened Sheets - On Exterior:
   1. Install sheets shingle-fashion to shed water, with seams generally horizontal.
   2. Overlap seams as recommended by manufacturer but at least 6 inches.
   3. Overlap at outside and inside corners as recommended by manufacturer but at least 12 inches.
   4. Attach to framed construction with fasteners extending through sheathing into framing. Space fasteners at 12 to 18 inches on center along each framing member supporting sheathing.
   5. Attach to masonry construction using mechanical fasteners spaced at 12 to 18 inches on center vertically and maximum 24 inches on center horizontally.
   6. For applications specified to be air tight, seal seams, laps, penetrations, tears, and cuts with self-adhesive tape; use only large-headed, gasketed fasteners recommended by the manufacturer.
   7. Where stud framing rests on concrete or masonry, extend lower edge of sheet at least 4 inches below bottom of framing and seal to foundation with sealant.
   8. Install water-resistive barrier over jamb flashings.
   9. Install air barrier and vapor retarder UNDER jamb flashings.
  10. Install head flashings under weather barrier.
  11. At openings to be filled with frames having nailing flanges, wrap excess sheet into opening; at head, seal sheet over flange and flashing.

G. Mechanically Fastened Sheets - Vapor Retarder On Interior:
   1. When insulation is to be installed in assembly, install vapor retarder over insulation.
   2. Anchor to metal framing using seam tape, adhering at least one-half of tape width to substrate.
   4. Locate laps at a framing member; at laps fasten one sheet to framing member then tape overlapping sheet to first sheet.
   5. Seal entire perimeter to structure, window and door frames, and other penetrations.
   6. Where conduit, pipes, wires, ducts, outlet boxes, and other items are installed in insulation cavity, pass vapor retarder sheet behind item but over insulation and maintain air tight seal.

H. Coatings:
   1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
   2. Use flashing to seal to adjacent construction and to bridge joints.

I. Openings and Penetrations in Exterior Weather Barriers:
   1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
   2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with at least 4 inches wide; do not seal sill flange.
   3. At openings to be filled with non-flanged frames, seal weather barrier to all sides of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.
4. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.
5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

3.04 FIELD QUALITY CONTROL
A. Coordination of ABAA Tests and Inspections:
   1. Provide testing and inspection required by ABAA QAP.
   2. Notify in ABAA writing of schedule for air barrier work. Allow adequate time for testing and inspection.
   3. Cooperate with ABAA testing agency.
   4. Allow access to air barrier work areas and staging.
   5. Do not cover air barrier work until tested, inspected, and accepted.
B. Do not cover installed weather barriers until required inspections have been completed.
C. Obtain approval of installation procedures by the weather barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.
D. Take digital photographs of each portion of the installation prior to covering up.

3.05 PROTECTION
A. Do not leave materials exposed to weather longer than recommended by manufacturer.
B. Do not leave paper- or felt-based barriers exposed to weather for longer than one week.

END OF SECTION 07.25.00
SECTIONS 07.42.64
METAL COMPOSITE MATERIAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Self-supporting exterior curtain wall system consisting of formed metal composite material (MCM) sheet, framing, secondary supports, and anchors to structure.
B. Matching flashing and trim.

1.02 RELATED REQUIREMENTS
A. Section 03.30.00 - Cast-in-Place Concrete: Installation of anchors.
B. Section 04.20.00 - Unit Masonry: Installation of anchors.

1.03 REFERENCE STANDARDS
F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
G. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Pre-Installation Meeting: Convene one week before starting work of this section to verify project requirements, co-ordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers’ installation instructions and warranty requirements.
   1. Require attendance by the installer and relevant sub-contractors.
   2. Include MCM sheet manufacturer’s representative and wall system manufacturer’s representative to review storage and handling procedures.
   3. Review in detail truck transportation, parking, vertical transportation, schedule, personnel, installation of adjacent materials and substrate.
   4. Review procedures for protection of work and other construction.
   5. Review safety precautions.

1.05 SUBMITTALS
A. Product Data - MCM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
   1. Finish manufacturer's data sheet showing physical and performance characteristics.
   2. Storage and handling requirements and recommendations.
   3. Fabrication instructions and recommendations.
   4. Specimen warranty for finish, as specified herein.
B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
   1. Physical characteristics of components shown on shop drawings.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and recommendations.
   4. Specimen warranty for wall system, as specified herein.
C. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, number of anchors, supports, reinforcement, trim, flashings, and accessories.
   1. Indicate panel numbering system.
   2. Differentiate between shop and field fabrication.
   3. Indicate substrates and adjacent work with which the wall system must be coordinated.
   4. Include large-scale details of anchorages and connecting elements.
   5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than 1-1/2 inches per 12 inches.
   6. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
E. Certificate: Certify that the work results of this section meet or exceed specified requirements.
F. Design Data: Submit structural calculations stamped by design engineer, for Architect's information and project record.
G. Test Report: Submit report of full-size mock-up tests for air infiltration, water penetration, and wind performance.
I. Manufacturer's Field Reports: Provide within 48 hours of field review. State what was observed and what changes, if any, were requested or required.
J. Manufacturer's Qualification Statement.
K. Installer's Qualification Statement.
M. Maintenance Data: Care of finishes and warranty requirements.
N. Executed Warranty: Submit warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Field Measurements: Verify actual dimensions by field measurement before fabrication; show recorded measurements on shop drawings.
B. Design Engineer's Qualifications: Design structural supports and anchorages under direct supervision of a Structural Engineer experienced in design of this type of Work and licensed in Tennessee.
C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section.
   1. With not less than three (3) years of documented experience.
   2. Approved by MCM sheet manufacturer.
   3. Submit contact names and phone numbers for at least three references connected with successful past projects.
D. Installer Qualifications: Company specializing in performing work of the type specified in this section.
   1. With minimum three (3) years of documented experience.
   2. Approved by wall system manufacturer.
   3. Submit contact names and phone numbers for at least three references connected with successful past projects.
E. Testing Agency Qualifications: Independent agency experienced in testing assemblies of the type required for this project and having the necessary facilities for full-size mock-up testing of the type specified.
F. Mock-Up: Provide a mock-up for evaluation of fabrication workmanship.
   1. Locate where directed.
   2. Provide panels finished as specified.
   3. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
   1. Protect finishes by applying heavy duty removable plastic film during production.
   2. Package for protection against transportation damage.
   3. Provide markings to identify components consistently with drawings.
   4. Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.
B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
   1. Store in well ventilated space out of direct sunlight.
   2. Protect from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.
   3. Store at a slope to ensure positive drainage of any accumulated water.
   4. Do not store in any enclosed space where ambient temperature can exceed 120 degrees F.
   5. Avoid contact with any other materials that might cause staining, denting, or other surface damage.
1.08 WARRANTY

A. Wall System Warranty: Provide joint written warranty by manufacturer and installer, agreeing to correct defects in manufacturing or installation within a two year period after Date of Substantial Completion.

B. MCM Sheet Manufacturer’s Finish Warranty: Provide manufacturer's written warranty stating that the finish will perform as follows for minimum of 5 years:
   1. Chalking: No more than that represented by a No. 8 rating based on ASTM D4214.
   2. Color Retention: No fading or color change in excess of 5 Hunter color difference units, calculated in accordance with ASTM D2244.
   3. Gloss Retention: Minimum of 30 percent gloss retention, when tested in accordance with ASTM D523.

PART 2 PRODUCTS

2.01 WALL PANEL SYSTEM

A. Wall Panel System: Metal panels, fasteners, and anchors designed to be supported by framing or other substrate provided by others; provide installed panel system capable of maintaining specified performance without defects, damage or failure.
   1. Provide structural design by or under direct supervision of a Structural Engineer licensed in Tennessee.
   2. Provide panel jointing and weatherseal using a "wet", sealant-sealed system.
   3. Anchor panels to supporting framing without exposed fasteners.

B. Performance Requirements:
   1. All tests are to be on full-size mock-ups; tests performed previously for other projects are acceptable provided tested assemblies are truly equivalent to those to be used on this project, unless otherwise indicated.
   2. Thermal Movement: Provide for free and noiseless vertical and horizontal thermal movement due to expansion and contraction under material temperature range of minus 20 degrees F to 180 degrees F without buckling, opening of joints, undue stress on fasteners, or other detrimental effects; allow for ambient temperature at time of fabrication, assembly, and erection procedures.
   3. Wind Performance: Provide system tested in accordance with ASTM E330/E330M without permanent deformation or failures of structural members under the following conditions:
      a. Inward Design Wind Pressure: ___ psf.
      b. Outward Design Wind Pressure: ___ psf.
      c. Maximum deflection of perimeter framing member of L/175 normal to plane of the wall; maximum deflection of individual panels of L/60.
      d. Maximum anchor deflection in any direction of 1/16 inch at connection points of framing members to anchors.
   4. Air Infiltration: 0.06 cfm/sq ft of wall area, maximum, when tested at 1.57 psf in accordance with ASTM E283.
   5. Water Penetration: No water penetration under static pressure when tested in accordance with ASTM E331 at a differential of 10 percent of inward acting design load, 6.24 psf minimum, after 15 minutes.
      a. Water penetration is defined as the appearance of uncontrolled water on the interior face of the wall.
      b. Design to drain leakage and condensation to the exterior face of the wall.
   6. Fire Performance: Tested in accordance with, and complying with the acceptance criteria of, NFPA 285; testing must be performed specifically for this project.

C. Panels: One inch deep pans formed of metal composite material sheet by routing back edges of sheet, removing corners, and folding edges.
   1. Reinforce corners with riveted aluminum angles.
2. Provide concealed attachment to supporting structure by adhering attachment members to back of panel; attachment members may also function as stiffeners.
3. Maintain maximum panel bow of 0.8 percent of panel dimension in width and length; provide stiffeners of sufficient size and strength to maintain panel flatness without showing local stresses or read-through on panel face.
4. Secure members to back face of panels using structural silicone sealant approved by MCM sheet manufacturer.
5. Fabricate panels under controlled shop conditions.
6. Where final dimensions cannot be established by field measurement before commencement of manufacturing, make allowance for field adjustments without requiring field fabrication of panels.
7. Fabricate as indicated on drawings and as recommended by MCM sheet manufacturer.
   a. Make panel lines, breaks, curves and angles sharp and true.
   b. Keep plane surfaces free from warp or buckle.
   c. Keep panel surfaces free of scratches or marks caused during fabrication.
8. Provide joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration on inside face of panel system.
9. For "dry" jointing, secure extrusions to returned pan edges with stainless steel rivets; provide means of concealed drainage with baffles and weeps for water that might accumulate in members of system.

2.02 MATERIALS

A. Metal Composite Material (MCM) Sheet: Two sheets of aluminum sandwiching a core of extruded thermoplastic material; no foamed insulation material content.
   1. Overall Sheet Thickness: 3 mm, minimum.
   2. Face Sheet Thickness: 0.019 inches, minimum.
   3. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.
   4. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
   5. Flammability: Self-ignition temperature of 650 degrees F or greater, when tested in accordance with ASTM D1929.
   6. Factory Finish: Two coats fluoropolymer resin coating, approved by the coating manufacturer for the length of warranty specified for the project, and applied by coil manufacturing facility that specializes in coil applied finishes.
      b. Long-Term Performance: Not less than that specified under WARRANTY in PART 1.

B. Metal Framing Members: Include sub-girts, zee-clips, base and sill angles and channels, hat-shaped and rigid channels, and furring channels required for complete installation.
   1. Provide material strength, dimensions, configuration as required to meet the applied loads applied and in compliance with applicable building code.
   2. Sheet Steel Components: ASTM A653/A653M galvanized to G90/Z275 or zinc-iron alloy-coated to A60/ZF180; or ASTM A792/A792M aluminum-zinc coated to AZ60/AZM180.
   3. Stainless Steel Sheet Components: ASTM A480/A480M.

C. Flashing: Sheet aluminum; 0.040 inch thick, minimum; finish and color to match MCM sheet.

D. Anchors, Clips and Accessories: Use one of the following:
   2. Steel complying with ASTM A36/A36M and hot-dipped galvanized to ASTM A153/A153M.

E. Fasteners:
   1. Exposed fasteners: Stainless steel; permitted only where absolutely unavoidable and subject to prior approval of the Architect.
   2. Screws: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal wall panels.
   4. Fasteners for Flashing and Trim: Blind fasteners of high-strength aluminum or stainless steel.

F. Provide panel system manufacturer's and installer’s standard corrosion resistant accessories, including fasteners, clips, anchorage devices and attachments.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify dimensions, tolerances, and interfaces with other work.
   B. Verify substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturers written instructions.
   C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
   D. Notify Architect in writing of conditions detrimental to proper and timely completion of work. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION
   A. Protect adjacent work areas and finish surfaces from damage during installation.
   B. Deliver anchorage items to be cast into concrete or built into masonry to appropriate installer(s) together with setting templates.

3.03 INSTALLATION
   A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.
   B. Comply with instructions and recommendations of MCM sheet manufacturer and wall system manufacturer, as well as with approved shop drawings.
   C. Install wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.
   D. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.
   E. Do not form panels in field unless required by wall system manufacturer and approved by the Architect; comply with MCM sheet manufacturer's instructions and recommendations for field forming.
   F. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.
   G. Where joints are designed for field applied sealant, seal joints completely with specified sealant.
   H. Install flashings as indicated on shop drawings. At flashing butt joints, provide a lap strap under flashing and seal lapped surfaces with a full bed of non-hardening sealant.
   I. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
1. Variation From Plane or Location: 1/2 inch in 30 feet of length and up to 3/4 inch in 300 feet, maximum.
2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet run, maximum.
3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet run, maximum.
4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch, maximum.

J. Replace damaged products.
1. Exception: Field repairs of minor damage to finishes are permitted only when approved in writing by Architect, panel manufacturer, and fabricator.
2. Field Repairs to Finishes: Using materials and methods sufficient that repairs are not discernible when viewed at distance of 10 feet under all typical light conditions experienced at the project.

3.04 FIELD QUALITY CONTROL
A. Wall System Manufacturer's Field Services: Provide field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with instructions.
B. Site Visits: Schedule two site visits during execution of installation.

3.05 CLEANING
A. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.
B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.
C. Remove temporary coverings and protection of adjacent work areas.
D. Clean installed products in accordance with manufacturer's instructions.

3.06 PROTECTION
A. Protect installed panel system from damage during construction.

END OF SECTION 07.42.64
1.01 SECTION INCLUDES
A. Adhered roof system with ethylene propylene diene terpolymer (EPDM) roofing membrane.
B. Vapor retarder.

1.02 RELATED REQUIREMENTS
A. Section 05.31.00 - Steel Decking.

1.03 REFERENCE STANDARDS
G. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; Factory Mutual System; 2006.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Preinstallation Meeting: Convene one week before starting work of this section.
   1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.05 SUBMITTALS
A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's written information listed below.
   1. Product data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements.
C. Sustainable Design Documentation:
   1. Test report showing solar reflectance index of membrane
   2. Certification documenting recycled content.
   3. Documentation of distance to manufacturing facilities.
   4. Documentation of adhesive and sealant contents.
D. Manufacturer's Qualification Statement.
E. Installer's Qualification Statement.
F. Specimen Warranty: For approval.
G. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.
H. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
I. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
J. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
K. Warranty:
   1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
   2. Submit installer's certification that installation complies with all warranty conditions for the waterproof membrane.

1.06 QUALITY ASSURANCE
A. Perform work in accordance with NRCA ML104.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum twenty (20) years of documented experience.
C. Installer Qualifications: Company specializing in performing the work of this section:
   1. With minimum five (5) years documented experience.
   2. Approved by membrane manufacturer.
   3. Extend manufacturer's labor and materials guarantee.
   4. Extend manufacturer's No Dollar Limit guarantee.
D. Single Source Responsibility: Provide and install products from single source.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
B. Store products in weather protected environment, clear of ground and moisture.
C. Protect foam insulation from direct exposure to sunlight.
D. Keep Material Safety Data Sheets (MSDS) at the project site at all times during transportation, storage, and installation of materials.
E. Comply with all requirements of Owner to prevent overloading or disturbance of the structure when loading materials onto the roof.

1.08 FIELD CONDITIONS
A. Do not apply roofing membrane during unsuitable weather. Refer to manufacturer's written instructions.
B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above ____ degrees F.
C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
E. Proceed with work so new roofing materials are not subject to construction traffic as work progresses.
F. Do not allow grease, oil, fats, or other contaminants to come into direct contact with membrane.
1.09 WARRANTY

A. Material Warranty: Provide membrane manufacturer's warranty agreeing to replace material that shows manufacturing defects within 10 years after installation.

B. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
   1. Warranty Term: 20 years.
   2. For repair and replacement include costs of both material and labor in warranty.
   3. Include damage caused by 2 inch maximum diameter hail.
   4. Exceptions NOT Permitted:
      a. Damage due to roof traffic.
      b. Damage due to wind of speed greater than 56 mph but less than 90 mph.

PART 2 PRODUCTS

2.01 ROOFING APPLICATIONS

A. EPDM Membrane Roofing: 60 mil non-reinforced single ply membrane, fully adhered, over vapor retarder and insulation.

B. Roofing Assembly Performance Requirements and Design Criteria:
   1. Wind Uplift:
      a. Designed to withstand wind uplift forces calculated with ASCE 7.
   2. Thermal Performance: Roof system insulation thermal value (R), minimum: R-20; provide insulation of thickness required.
   3. Drainage: No standing water within 48 hours after precipitation.

2.02 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Membrane:
   1. Material: Ethylene propylene diene terpolymer (EPDM); ASTM D4637/D4637M, Type I (non-reinforced).
   2. Thickness: 60 mils (0.060 inch), minimum.
   3. Sheet Width: Factory fabricated into largest sheets possible.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Membrane Fasteners: As recommended and approved by membrane manufacturer.

D. Vapor Retarder: Material approved by roof manufacturer complying with requirements of fire rating classification; compatible with roofing and insulation materials.
   1. Fire-retardant adhesive.

E. Flexible Flashing Material: Same material as membrane.

F. Base Flashing: Provide waterproof, fully adhered base flashing system at all penetrations, plane transitions, and terminations.

2.03 INSULATION

A. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, fiber reinforced felt both faces; Grade 2 and with the following characteristics:
   1. Compressive Strength: 20 pounds per square inch.
   2. Tapered Board: Slope as indicated; minimum thickness 1/4 inch; fabricate of fewest layers possible.
2.04 ACCESSORIES

A. Prefabricated Flashing Accessories:
   1. Corners and Seams: Same material as membrane, in manufacturer's standard thicknesses.
   2. Penetrations: Same material as membrane, with manufacturer's standard cut-outs, rigid inserts, clamping rings, and flanges.
   3. Sealant Pockets: Same material as membrane, with manufacturer's standard accessories, in manufacturer's standard configuration.
   4. Sure-Seal Pressure-Sensitive Reinforced Universal Securement Strip (RUSS):
      a. 9 inch wide, 45 mils (0.045 inch) thick, reinforced EPDM membrane with 3 inch wide, 30 mils (0.030 inch) thick cured synthetic rubber with pressure-sensitive adhesive laminated to both edges.

B. Insulation Adhesive: Two component polyurethane, expanding foam.

C. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self adhering.

D. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
   1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.

E. Membrane Adhesive: As recommended by membrane manufacturer.

F. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.

G. Strip Reglet Devices: Extruded plastic, maximum possible lengths per location, with attachment flanges.

H. Sealants: As recommended by membrane manufacturer.

I. Cleaner: Manufacturer's standard, clear, solvent-based cleaner.

J. Edgings and Terminations: Manufacturer's standard edge and termination accessories.
   1. Snap-On Edge System:
   2. Anchor Bar Fascia System:
   3. Drip Edge: Carlisle Sure-Seal Drip Edge.
   4. Coping:
   5. Termination Bar.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Perform work in accordance with manufacturer's instructions.

B. Do not apply roofing membrane during unsuitable weather.

C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

F. Coordinate the work with installation of associated counterflashings installed by other sections as the work of this section proceeds.

G. When substrate preparation is responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.
3.02 EXAMINATION
A. Verify that surfaces and site conditions are ready to receive work.
B. Verify deck is supported and secure.
C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
D. Verify deck surfaces are dry and free of snow or ice.
E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.03 PREPARATION, GENERAL
A. Clean substrate thoroughly prior to roof application.
B. Do not begin work until other work that requires foot or equipment traffic on roof is complete.
C. Apply manufacturer's recommended vapor retarder or temporary roof before roof installation.

3.04 CONCRETE DECK PREPARATION
A. Verify adjacent precast concrete roof members do not vary more than 1/4 inch in height. Verify grout keys are filled flush.
B. Fill surface honeycomb and variations with latex filler.
C. Confirm dry deck by moisture meter with 12 percent moisture maximum when tested per ASTM D4263.
D. Adhered to Deck with Asphalt: Prime concrete deck with ASTM D41/D41M primer. Allow primer to dry completely before applying hot asphalt.

3.05 METAL DECK PREPARATION
A. Install preformed sound absorbing glass fiber insulation strips supplied by Section 05.31.00 in acoustic deck flutes. Install in accordance with manufacturer's instructions.
B. Install deck sheathing on metal deck:
   1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
   2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
   3. Tape joints.
C. Mechanically fasten sheathing to roof deck, in accordance with Factory Mutual recommendations and roofing manufacturer's instructions.
   1. Over entire roof area, fasten sheathing using 6 fasteners with washers per sheathing board.
   2. At roof perimeter to a distance of 4 ft in from edges, fasten sheathing using 6 fasteners with washers per board.

3.06 VAPOR RETARDER AND INSULATION
A. Apply vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
   1. Extend vapor retarder under cant strips and blocking to deck edge.
   2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.
B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.
C. Attachment of Insulation:
   1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions and Factory Mutual requirements.
   2. Embed second layer of insulation into full bed of adhesive in accordance with roofing and insulation manufacturers' instructions.
D. Do not install wet, damaged, or warped insulation boards.
E. Lay subsequent layers of insulation with joints staggered minimum 6 inch from joints of preceding layer.
F. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
G. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.
H. Lay boards with edges in moderate contact without forcing, and gap between boards no greater than 1/4 inch. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
I. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.
J. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches.
K. Do not apply more insulation than can be completely waterproofed in the same day.

3.07 MEMBRANE APPLICATION
A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
B. Shingle joints on sloped substrate in direction of drainage.
C. Fully Adhered Application: Apply adhesive at manufacturer's recommended rate. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof.
E. At intersections with vertical surfaces:
   1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
   2. Fully adhere flexible flashing over membrane and up to nailing strips.
   3. Secure flashing to nailing strips at 4 inches on center.
   4. Insert flashing into reglets and secure.
F. At gravel stops, extend membrane under gravel stop and to the outside face of the wall.
G. Install roofing expansion joints where indicated. Make joints watertight.
H. Install prefabricated joint components in accordance with manufacturer's instructions.
I. Coordinate installation of roof drains and sumps and related flashings. Locate all field splices away from low areas and roof drains. Lap upslope sheet over downslope sheet.
J. Install walkway pads at areas of concentrated traffic and as shown on Drawings. Space pad joints to permit drainage.
K. Daily Seal: Install daily seal per manufacturers instructions at the end of each work day. Prevent infiltration of water at incomplete flashings, terminations, and at unfinished membrane edges.

3.08 FIELD QUALITY CONTROL
A. Require site attendance of roofing and insulation material manufacturers daily during installation of the Work.

3.09 CLEANING
A. Remove wrappings, empty containers, paper, and other debris from the roof daily. Dispose of debris in compliance with local, State, and Federal regulations.
B. Remove bituminous markings from finished surfaces.
C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
D. Repair or replace defaced or damaged finishes caused by work of this section.
3.10 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION 07.53.23
PART 1  GENERAL

1.01  SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, and sheet metal roofing.
B. Sealants for joints within sheet metal fabrications.
C. Reglets and accessories.
D. Precast concrete splash pads.

1.02  RELATED REQUIREMENTS

A. Section 07.61.00 - Sheet Metal Roofing.

1.03  REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

1.04  SUBMITTALS

A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.05  QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with ten years of documented experience.

1.06  DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
B. Prevent contact with materials that could cause discoloration or staining.

PART 2  PRODUCTS

2.01  SHEET MATERIALS

A. Stainless Steel: ASTM A666, Type 304, soft temper, 28 gage (0.0156 inch) thick; smooth No. 4 finish.
B. Copper: ASTM B370, cold rolled 16 oz/sq ft (24 gage) (0.0216 inch) thick; natural finish.
2.02 ACCESSORIES
A. Fasteners: Stainless steel, with soft neoprene washers.
B. Slip Sheet: Rosin sized building paper.
C. Primer: Zinc chromate type.
D. Protective Backing Paint: Zinc molybdate alkyd.
E. Sealant to be Concealed in Completed Work: Non-curing butyl sealant.
F. Sealant to be Exposed in Completed Work: ASTM C920; elastomeric sealant, 100 percent silicone with minimum movement capability of plus/minus 25 percent and recommended by manufacturer for substrates to be sealed; clear.
G. Plastic Cement: ASTM D4586/D4586M, Type I.

2.03 FABRICATION
A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
B. Form pieces in longest possible lengths.
C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
D. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
F. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.04 GUTTER AND DOWNSPOUT FABRICATION
A. Downspouts: Rectangular profile.
B. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA (ASMM).
C. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.
D. Downspout Boots: Steel.
E. Seal metal joints.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION
A. Install starter and edge strips, and cleats before starting installation.
B. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.
C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION
A. Insert flashings into reglets to form tight fit. Secure in place with lead wedges. Pack remaining spaces with lead wool. Seal flashings into reglets with sealant.
B. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
C. Apply plastic cement compound between metal flashings and felt flashings.
D. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
E. Seal metal joints watertight.
F. Secure gutters and downspouts in place using concealed fasteners.
G. Slope gutters 1/4 inch per 10 feet, minimum.
H. Connect downspouts to downspout boots. Grout connection watertight.
I. Set splash pads under downspouts.

3.04 FIELD QUALITY CONTROL
   A. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION 07.62.00
SECTION 07.71.00
ROOF SPECIALTIES

PART 1  GENERAL

1.01  SECTION INCLUDES
A. Manufactured roof specialties, including copings, fascias, gravel stops, and vents.
B. Roof membrane vents.

1.02  RELATED REQUIREMENTS

1.03  REFERENCE STANDARDS

1.04  SUBMITTALS
A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
C. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.
D. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

1.05  QUALITY ASSURANCE
A. Perform work in accordance with SMACNA (ASMM) details.

PART 2  PRODUCTS

2.01  COMPONENTS
A. Roof Edge Flashings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.
   1. Configuration: Fascia, cant, and edge securement for roof membrane;
   2. Pull-Off Resistance: Tested in accordance with SPRI ES-1 RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable code.
B. Copings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.
   1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness and finish as cap; concealed stainless steel fasteners.
   2. Pull-Off Resistance: Tested in accordance with SPRI ES-1 RE-3 to positive and negative design wind pressure as defined by applicable code.
   3. Material: Formed aluminum sheet, 0.050 inch thick, minimum.
C. Roofing Vents: Formed aluminum 0.050 inch thick, of watertight construction to permit construction below roof membrane to breathe; with attachment flanges 6 inch wide.
   1. Finish: Mill finish.
   2. Color: To be selected by Architect from manufacturer's standard range.
D. Pipe and Penetration Flashing: Base of rounded aluminum, compatible with sheet metal roof systems, and capable of accommodating pipes sized between 0.375 inches and 12 inches.

2.02 ACCESSORIES
A. Sealant for Joints in Linear Components: As recommended by component manufacturer.
B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.

2.03 FINISHES
A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system; color as selected from manufacturer's standard colors.
B. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as selected from manufacturer's standard colors.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly

3.02 INSTALLATION
A. Install components in accordance with manufacturer's instructions.
B. Seal joints within components when required by component manufacturer.
C. Anchor components securely.
D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
E. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.
F. Coordinate installation of flashing flanges into reglets.

END OF SECTION 07.71.00
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Manufactured curbs, equipment rails, and pedestals.
   B. Roof hatches, manual and automatic operation, including smoke vents.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS
   C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
   D. FM (AG) - FM Approval Guide; current edition.
   F. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 SUBMITTALS
   A. Product Data: Manufacturer's data sheets on each product to be used.
      1. Preparation instructions and recommendations.
      2. Storage and handling requirements and recommendations.
      3. Installation methods.
      4. Maintenance requirements.
      5. For smoke hatches, submit evidence of approval by evaluation agency specified.
   B. Shop Drawings: Submit detailed layout developed for this project. Show dimensioned location and number for each type of roof accessory.
      1. Non-penetrating Rooftop Supports: Submit design calculations for loadings and spacings.
      2. Submit shop drawings sealed and signed by a Professional Engineer experienced in design of this type of work and licensed in Tennessee.
   C. Certificate: For smoke hatches, provide certificate of approval from authority having jurisdiction.
   D. Warranty Documentation:
      1. Submit manufacturer warranty.
      2. Ensure that forms have been completed in Owner's name and registered with manufacturer.
      3. Submit documentation that roof accessories accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

1.05 DELIVERY, STORAGE, AND HANDLING
   A. Store products in manufacturer's unopened packaging until ready for installation.
   B. Store products under cover and elevated above grade.

1.06 WARRANTY
   A. Correct defective Work within a five year period after Date of Substantial Completion.
PART 2 PRODUCTS

2.01 MANUFACTURED CURBS

A. Manufactured Curbs, Equipment Rails, and Other Roof Mounting Assemblies:

B. Manufactured Curbs, Equipment Rails, and Other Roof Mounting Assemblies: Factory-assembled hollow sheet metal construction with fully mitered and welded corners, integral counterflashing, internal reinforcing, and top side and edges formed to shed water.
   1. Sheet Metal: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33; G60 coating designation; 18 gage, 0.048 inch thick.
   2. Roofing Cants: Provide integral sheet metal roofing cants dimensioned to begin slope at top of roofing insulation; 1:1 slope; minimum cant height 4 inches.
   3. Manufacture curb bottom and mounting flanges for installation directly on roof deck, not on insulation; match slope and configuration of roof deck.
   4. Provide the layouts and configurations shown on the drawings.

C. Curbs Adjacent to Roof Openings: Provide curb on all sides of opening, with top of curb horizontal for equipment mounting.
   1. Provide preservative treated wood nailers along top of curb.
   2. Insulate inside curbs with 1-1/2 inch thick fiberglass insulation.
   3. Height Above Finished Roof Surface: 6 inches, minimum.
   4. Height Above Roof Deck: 14 inches, minimum.

D. Equipment Rails: Two-sided curbs in straight lengths, with top horizontal for equipment mounting.
   1. Provide preservative treated wood nailers along top of rails.
   2. Height Above Finished Roof Surface: 6 inches, minimum.
   3. Height Above Roof Deck: 14 inches, minimum.

E. Pipe, Duct, and Conduit Mounting Pedestals: Vertical posts, minimum 8 inches square unless otherwise indicated.
   1. Provide sliding channel welded along top edge with adjustable height steel bracket, manufactured to fit item supported.
   2. Height Above Finished Roof Surface: 6 inches, minimum.
   3. Height Above Roof Deck: 14 inches, minimum.

2.02 ROOF HATCHES, MANUAL AND AUTOMATIC OPERATION

A. Roof Hatches and Smoke Vents, General: Factory-assembled steel frame and cover, complete with operating and release hardware.
   1. Style: Provide flat metal covers unless otherwise indicated.
   2. Mounting: Provide frames and curbs suitable for mounting on flat roof deck.
   3. Thermally Broken Hatches: Added insulation to frame and cover; available in all manufacturer's standard, single leaf sizes; special sizes available upon request
   4. Size(s): As indicated on drawings; single-leaf style unless indicated as double-leaf.

B. Smoke and Heat Vents: Where "smoke" or "smoke/heat" operation is indicated, provide the following additional features and omit manual operation for access:
   1. Smoke Release Mechanism: Automatic opening on melting of replaceable UL (DIR) listed fusible link at 165 deg F.
   2. UL (DIR) or FM (AG) listed as automatically operated smoke and heat vent.
   3. Fire Alarm Connection: Provide separate resettable electrical link release mechanism and connection point for fire alarm system.

C. Frames/Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
1. Material: Galvanized steel, 14 gage, 0.0747 inch thick.
3. Insulation: Manufacturer's standard; 1 inch rigid glass fiber, located on outside face of curb.
4. Curb Height: 12 inches from finished surface of roof, minimum.

D. Metal Covers: Flush, insulated, hollow metal construction.
   1. Capable of supporting 40 psf live load.
   2. Material: Galvanized steel; outer cover 14 gage, 0.0747 inch thick, liner 22 gage, 0.03 inch thick.
   4. Insulation: Manufacturer's standard 1 inch rigid glass fiber.
   5. Gasket: Neoprene, continuous around cover perimeter.

E. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
   1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
   2. Hinges: Heavy duty pintle type.
   3. Hold open arm with vinyl-coated handle for manual release.
   6. Smoke Hatches: Manual release operation not to disturb automatic release mechanisms; easy resetting by Owner's maintenance personnel; provide latch designed to prevent relatching unless the automatic release mechanism has been properly reset for automatic operation.
   7. Locking: Padlock hasp on interior.

2.03 NON-PENETRATING ROOFTOP ASSEMBLIES

A. Non-Penetrating Rooftop Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly.
   1. Design Loadings and Configurations: As required by applicable codes.
   2. Height: Provide minimum clearance of 6 inches under supported items to top of roofing.
   3. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   4. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
   5. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

B. Pipe Supports: Provide attachment fixtures complying with MSS SP-58 and as indicated.

C. Duct Supports:

D. Non-Penetrating Pedestals: Steel pedestals with square, round, or rectangular bases.
   2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
3.02 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.

3.03 INSTALLATION
   A. Install in accordance with manufacturer's instructions, in manner that maintains roofing weather integrity.

3.04 CLEANING
   A. Clean installed work to like-new condition.

3.05 PROTECTION
   A. Protect installed products until completion of project.
   B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 07.72.00
SECTION 07.81.00
APPLIED FIREPROOFING

PART 1  GENERAL

1.01  SECTION INCLUDES
   A. Fireproofing of interior structural steel not exposed to damage or moisture.
   B. Fireproofing of structural steel exposed to damage or moisture.
   C. Preparation of fireproofing for application of finish specified elsewhere.

1.02  RELATED REQUIREMENTS

1.03  REFERENCE STANDARDS

1.04  ADMINISTRATIVE REQUIREMENTS
   A. Coordinate with placement of ceiling hanger tabs, mechanical component hangers, and electrical components.
   B. Preinstallation Meeting: Convene one week before starting work of this section.

1.05  SUBMITTALS
   A. Product Data: Provide data indicating product characteristics.
   B. Test Reports: Reports from reputable independent testing agencies for proposed products, indicating compliance with specified criteria, conducted under conditions similar to those on project, for:
      1. Bond Strength.
      2. Bond Impact.
      3. Compressive Strength.
      4. Fire tests using substrate materials similar those on project.
   C. Manufacturer's Installation Instructions: Indicate special procedures.
   D. Manufacturer's Certificate: Certify that sprayed-on fireproofing products meet or exceed requirements of contract documents.
   E. Manufacturer's Field Reports: Indicate environmental conditions under which fireproofing materials were installed.

1.06  QUALITY ASSURANCE
   A. Installer Qualifications: Company specializing in performing work of the type specified in this section, and:
      1. Having minimum five years of documented experience.
      2. Approved by manufacturer.
1.07 FIELD CONDITIONS
   A. Do not apply spray fireproofing when temperature of substrate material and surrounding air is below 40 degrees F or when temperature is predicted to be below said temperature for 24 hours after application.
   B. Provide ventilation in areas to receive fireproofing during application and 24 hours afterward, to dry applied material.
   C. Provide temporary enclosure to prevent spray from contaminating air.
   D. Do not allow roof traffic during installation of roof fireproofing and drying period.

1.08 WARRANTY
   A. Correct defective Work within a five year period after Date of Substantial Completion.
      1. Include coverage for fireproofing to remain free from cracking, checking, dusting, flaking, spalling, separation, and blistering.
      2. Reinstall or repair failures that occur within warranty period.

PART 2 PRODUCTS

2.01 FIREPROOFING ASSEMBLIES
   A. Provide assemblies as indicated on the drawings.

2.02 MATERIALS
   A. Sprayed Fire-Resistive Material for Interior Applications, Concealed: Manufacturer's standard factory mixed material, which when combined with water is capable of providing the indicated fire resistance, and conforming to the following requirements:
      1. Bond Strength: 150 pounds per square foot, minimum, when tested in accordance with ASTM E736 when set and dry.
      2. Dry Density: As required by fire resistance design.
      3. Compressive Strength: 8.33 pounds per square inch, minimum.
      4. Effect of Impact on Bonding: No cracking, spalling or delamination, when tested in accordance with ASTM E760.
      5. Corrosivity: No evidence of corrosion, when tested in accordance with ASTM E937.
      6. Surface Burning Characteristics: Maximum flame spread index of 0 (zero) and maximum smoke developed index of 0 (zero), when tested in accordance with ASTM E84.
   B. Sprayed Fire-Resistive Material Exposed to Damage or Moisture: Manufacturer's standard factory mixed material, which when combined with water is capable of providing the indicated fire resistance, and conforming to the following requirements:
      2. Bond Strength: 1000 pounds per square foot, minimum, when tested in accordance with ASTM E736 when set and dry.
      3. Dry Density: As required by fire resistance design.
      4. Effect of Impact on Bonding: No cracking, spalling or delamination, when tested in accordance with ASTM E760.
      5. Corrosivity: No evidence of corrosion, when tested in accordance with ASTM E937.
      6. Air Erosion Resistance: Weight loss of 0.025 g/sq ft, maximum, when tested in accordance with ASTM E859 after 24 hours.
      7. Surface Burning Characteristics: Maximum flame spread index of 0 (zero) and maximum smoke developed index of 0 (zero), when tested in accordance with ASTM E84.

2.03 ACCESSORIES
   A. Primer Adhesive: Of type recommended by fireproofing manufacturer.
PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that surfaces are ready to receive fireproofing.
B. Verify that clips, hangers, supports, sleeves, and other items required to penetrate fireproofing are in place.
C. Verify that ducts, piping, equipment, or other items that would interfere with application of fireproofing have not been installed.
D. Verify that voids and cracks in substrate have been filled. Verify that projections have been removed where fireproofing will be exposed to view as a finish material.

3.02 PREPARATION
A. Perform tests as recommended by fireproofing manufacturer in situations where adhesion of fireproofing to substrate is in question.
B. Remove incompatible materials that could affect bond by scraping, brushing, scrubbing, or sandblasting.
C. Prepare substrates to receive fireproofing in strict accordance with instructions of fireproofing manufacturer.
D. Apply fireproofing manufacturer's recommended bonding agent on primed steel.
E. Protect surfaces not scheduled for fireproofing and equipment from damage by overspray, fall-out, and dusting.
F. Close off and seal duct work in areas where fireproofing is being applied.

3.03 APPLICATION
A. Install metal lath over structural members as indicated or as required by UL Assembly Design Numbers.
B. Apply primer adhesive in accordance with manufacturer's instructions.
C. Apply fireproofing in thickness and density necessary to achieve required ratings, with uniform density and texture.
D. In exposed locations, trowel surface smooth and form square edges, using tools and procedures recommended by fireproofing manufacturer.

3.04 FIELD QUALITY CONTROL
A. Inspect the installed fireproofing after application and curing for integrity, prior to its concealment. Ensure that actual thicknesses, densities, and bond strengths meet requirements for specified ratings and requirements of the Authority Having Jurisdiction.
B. Remove and replace installed fireproofing that does not comply with specified requirements, as directed by Architect.
C. Re-inspect the installed fireproofing for integrity of fire protection, after installation of subsequent Work.

3.05 CLEANING
A. Remove excess material, overspray, droppings, and debris.
B. Remove fireproofing from materials and surfaces not required to be fireproofed.
C. At exposed fireproofing, clean surfaces that have become soiled or stained, using manufacturer's recommended procedures.

END OF SECTION 07.81.00
PART 1 GENERAL -- NOT USED

PART 2 PRODUCTS

2.01 FIRESTOPPING - GENERAL REQUIREMENTS

A. Firestopping: Any material meeting requirements.

B. Firestopping Materials with Volatile Content: Provide only products having lower volatile organic compound (VOC) content than required by SCAQMD 1168.

C. Mold Resistance: Provide firestopping materials with mold and mildew resistance rating of 0 as determined by ASTM G21.

D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

2.02 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.

   I. Fire Ratings: Use any system listed by UL that has F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and that meets all other specified requirements.

B. Firestopping Between Edge of Floor Slab and Curtain Wall (without Penetrations): Fiber firestopping with smoke seal coating; UL Design No. TBD.

C. Firestopping Between Top of Partition Wall and Roof Slab: Fiber firestopping with smoke seal coating; UL Design No. TBD, F Rating TBD.

D. Temporary Firestopping: Reusable intumescent shapes; UL Design No. TBD, F Rating 1-1/2 hour.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

C. Install backing materials to arrest liquid material leakage.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed firestopping until inspected by Owner's Independent Testing Agency.

C. Do not cover installed firestopping until inspected by authorities having jurisdiction.

D. Install labeling required by code.

3.04 FIELD QUALITY CONTROL

B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.05 CLEANING
A. Clean adjacent surfaces of firestopping materials.

3.06 PROTECTION
A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 07.84.00
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Nonsag gunnable joint sealants.
   B. Self-leveling pourable joint sealants.
   C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS
   A. Section 01.61.16 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for
      sealants and primers.

1.03 REFERENCE STANDARDS
   A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a
      Durometer; 2006 (Reapproved 2011).
      (Reapproved 2012).
      Sealants; 2002 (Reapproved 2013).
   K. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints;
      2013.
   L. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.

1.04 SUBMITTALS
   A. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that
      includes the following.
      1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and
         color availability.
      2. List of backing materials approved for use with the specific product.
      3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
      4. Substrates the product should not be used on.
      5. Substrates for which use of primer is required.
      6. Substrates for which laboratory adhesion and/or compatibility testing is required.
      7. Installation instructions, including precautions, limitations, and recommended backing materials and
         tools.
      8. Sample product warranty.
      9. Certification by manufacturer indicating that product complies with specification requirements.
B. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

D. Sustainable Design Documentation: For sealants and primers, submit VOC content and emissions documentation as specified in Section 01.61.16.

E. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

F. Installation Plan: Submit at least four weeks prior to start of installation.

G. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

H. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

I. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

J. Installation Log: Submit filled out log for each length or instance of sealant installed.

K. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

D. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.

   3. Stain Testing: In accordance with ASTM C1248; required only for stone substrates.
   4. Allow sufficient time for testing to avoid delaying the work.
   5. Deliver to manufacturer sufficient samples for testing.
   6. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
   7. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

E. Installation Plan: Include schedule of sealed joints, including the following.

   1. Joint width indicated in contract documents.
   2. Joint depth indicated in contract documents; to face of backing material at centerline of joint.
   3. Method to be used to protect adjacent surfaces from sealant droppings and smears, with acknowledgement that some surfaces cannot be cleaned to like-new condition and therefore prevention is imperative.
   4. Approximate date of installation, for evaluation of thermal movement influence.
   5. Installation Log Form: Include the following data fields, with known information filled out.
      a. Unique identification of each length or instance of sealant installed.
      b. Location on project.
      c. Substrates.
      d. Sealant used.
      e. Stated movement capability of sealant.
f. Primer to be used, or indicate as "No primer" used.
g. Size and actual backing material used.
h. Date of installation.
i. Name of installer.
j. Actual joint width; provide space to indicate maximum and minimum width.
k. Actual joint depth to face of backing material at centerline of joint.
l. Air temperature.

F. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
1. Identification of testing agency.
2. Name(s) of sealant manufacturers' field representatives who will be observing
3. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
   a. Test date.
   b. Copy of test method documents.
   c. Age of sealant upon date of testing.
   d. Test results, modeled after the sample form in the test method document.
   e. Indicate use of photographic record of test.

G. Field Quality Control Plan:
1. Visual inspection of entire length of sealant joints.
2. Non-destructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
3. Destructive field adhesion testing of sealant joints, except interior acrylic latex sealant.
   a. For each different sealant and substrate combination, allow for one test every 100 feet in the first 1000 linear feet, and one test per 1000 linear feet thereafter, or once per floor on each elevation.
   b. If any failures occur in the first 1000 linear feet, continue testing at frequency of one test per 500 linear feet at no extra cost to Owner.
4. Field testing agency's qualifications.
5. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.

H. Field Adhesion Test Procedures:
1. Allow sealants to fully cure as recommended by manufacturer before testing.
2. Have a copy of the test method document available during tests.
3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

I. Non-Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.

J. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
1. Sample: At least 18 inch long.
2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch
by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.

3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.

4. Record results on Field Quality Control Log.

5. Repair failed portions of joints.

K. Field Adhesion Tests of Joints: Test for adhesion using most appropriate method in accordance with ASTM C1521, or other applicable method as recommended by manufacturer.

1.06 WARRANTY

A. See Section 01.78.00 - Closeout Submittals, for additional warranty requirements.

B. Correct defective work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

A. Scope:

1. Exterior Joints: Seal open joints, whether or not the joint is indicated on the drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
   a. Wall expansion and control joints.
   b. Joints between door, window, and other frames and adjacent construction.
   c. Joints between different exposed materials.
   d. Openings below ledge angles in masonry.
   e. Other joints indicated below.

2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
   a. Joints between door, window, and other frames and adjacent construction.
   b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
   c. Other joints indicated below.

3. Do not seal the following types of joints.
   a. Intentional weepholes in masonry.
   b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
   c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
   d. Joints where installation of sealant is specified in another section.
   e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use nonsag non-staining silicone sealant, unless otherwise indicated.

1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing.
2. Lap Joints between Manufactured Metal Panels: Butyl rubber, non-curing.
3. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.

C. Interior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.

2. Wall, Ceiling, and Floor Joints Where Tamper-Resistance is Required: Nonsag tamper-resistant polyurethane sealant.
3. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
4. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.

D. Interior Wet Areas: Bathrooms and restrooms; fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.

E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

2.02 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

2.03 NONSAG JOINT SEALANTS

A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 50 percent, minimum.
   2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
   3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.

B. Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   3. Color: To be selected by Architect from manufacturer's standard range.
   4. Cure Type: Single-component, neutral moisture curing
   5. Service Temperature Range: Minus 65 to 180 degrees F.

C. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.

D. Silyl-Terminated Polyether (STPE) and Polyurethane (STPU) Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 35 percent, minimum.
   2. Hardness Range: 20 to 40, Shore A, when tested in accordance with ASTM C661.
   3. Color: To be selected by Architect from manufacturer's standard range.
   4. Service Temperature Range: Minus 40 to 180 degrees F.

E. Tamper-Resistant, Silyl-Terminated Polyurethane (STPU) Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 12-1/2 percent, minimum
   2. Hardness Range: 50 to 60, Shore A, when tested in accordance with ASTM C661.

F. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multicomponent; not expected to withstand continuous water immersion or traffic.

G. Polyurethane Sealant for Continuous Water Immersion: ASTM C920, Grade NS, Uses M and A; single or multicomponent; explicitly approved by manufacturer for continuous water immersion; suitable for traffic exposure when recessed below traffic surface.
   1. Movement Capability: Plus and minus 35 percent, minimum.
H. Non-Sag "Traffic-Grade" Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion and traffic without the necessity to recess sealant below traffic surface.
2. Hardness Range: 40 to 50, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Architect from manufacturer's standard range.

I. Tamper-Resistant Polyurethane Sealant: ASTM C920, Grade NS, Uses M, G, and A; single or multicomponent; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 12-1/2 percent, minimum.
2. Hardness Range: 50 to 60, Shore A, when tested in accordance with ASTM C661.

J. Epoxy Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Hardness Range: 65 to 75, Shore A, when tested in accordance with ASTM C661.
2. Color: To be selected by Architect from manufacturer's standard range.
3. Service Temperature Range: Minus 40 to 180 degrees F.

K. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.

L. Non-Curing Butyl Sealant: Solvent-based; ASTM C1311; single component, nonsag, non-skimming, non-hardening, non-bleeding; vapor-impermeable; intended for fully concealed applications.

2.04 SELF-LEVELING SEALANTS

A. Self-Leveling Silicone Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.

B. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion.

2.05 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
3. Open Cell: 40 to 50 percent larger in diameter than joint width.
4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.
PART 3  EXECUTION

3.01  EXAMINATION
A. Verify that joints are ready to receive work.
B. Verify that backing materials are compatible with sealants.
C. Verify that backer rods are of the correct size.
D. Preinstallation Adhesion Testing: Install a sample for each test location shown in the test plan.
   1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
   2. Notify Architect of date and time that tests will be performed, at least 7 days in advance.
   3. Arrange for sealant manufacturer's technical representative to be present during tests.
   4. Record each test on Preinstallation Adhesion Test Log as indicated.
   5. If any sample fails, review products and installation procedures, consult manufacturer, or take whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Architect.
   6. After completion of tests, remove remaining sample material and prepare joint for new sealant installation.

3.02  PREPARATION
A. Remove loose materials and foreign matter that could impair adhesion of sealant.
B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03  INSTALLATION
A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
B. Perform installation in accordance with ASTM C1193.
C. Perform acoustical sealant application work in accordance with ASTM C919.
D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
E. Install bond breaker backing tape where backer rod cannot be used.
F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04  FIELD QUALITY CONTROL
A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
B. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.

C. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet, notify Architect immediately.

D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

E. Repair destructive test location damage immediately after evaluation and recording of results.

3.05 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at the low temperature in the thermal cycle. Report failures immediately and repair.

END OF SECTION 07.92.00
SECTION 08.11.13
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Non-fire-rated hollow metal doors and frames.
B. Hollow metal frames for wood doors.
C. Fire-rated hollow metal doors and frames.
D. Thermally insulated hollow metal doors with frames.
E. Sound-rated hollow metal doors and frames.
F. Hollow metal borrowed lites glazing frames.
G. Accessories, including glazing, louvers, and matching panels.

1.02 RELATED REQUIREMENTS
A. Section 08.71.00 - Door Hardware.
B. Section 08.80.00 - Glazing: Glass for doors and borrowed lites.

1.03 ABBREVIATIONS AND ACRONYMS
B. ASCE - American Society of Civil Engineers.
C. HMMA - Hollow Metal Manufacturers Association.
D. NAAMM - National Association of Architectural Metal Manufacturers.
F. SDI - Steel Door Institute.
G. UL - Underwriters Laboratories.

1.04 REFERENCE STANDARDS
C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
I. ASTM E413 - Classification for Rating Sound Insulation; 2010.
J. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.
L. ITS (DIR) - Directory of Listed Products; current edition.
M. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
N. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
S. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.05 SUBMITTALS
A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
C. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.06 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 DESIGN CRITERIA
A. Requirements for Hollow Metal Doors and Frames:
   1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements; Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.
   3. Typical Door Face Sheets: Flush.
4. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
5. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
   a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.

B. Hollow Metal Panels: Same construction, performance, and finish as doors.

C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.02 HOLLOW METAL DOORS

A. Exterior Doors: Thermally insulated.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 2 - Heavy-duty.
      b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
      e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
   2. Core Material: Polyurethane, 1.8 lbs/cu ft minimum density.
   3. Door Thermal Resistance: R-Value of 8.7, minimum, for installed thickness of polyurethane.
   5. Door Face Sheets: Flush.
   6. Weatherstripping: Integral, recessed into door edge or frame.
   7. Door Finish: Factory primed and field finished.

B. Interior Doors, Non-Fire Rated:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 2 - Heavy-duty.
      b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
      e. Zinc Coating: Not required; ASTM A653/A653M.
   2. Core Material: Manufacturers standard core material/construction and in compliance with requirements.

C. Fire-Rated Doors:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 2 - Heavy-duty.
      b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
      e. Zinc Coating: Not required; ASTM A653/A653M.
   2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
   3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
a. Attach fire rating label to each fire rated unit.
4. Core Material: Manufacturers standard core material/construction in compliance with requirements.

D. Sound-Rated Interior Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
   a. Level 2 - Heavy-duty.
   b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 1 - Full Flush.
   d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
   e. Zinc Coating: Not required; ASTM A653/A653M.
2. Sound Transmission Class (STC) Rating of Door and Frame Assembly: STC of 35, calculated in accordance with ASTM E413, and tested in accordance with ASTM E90.
3. Core Material: Manufacturer's standard construction as required to meet acoustic requirements indicated.
4. Door Thickness: As required to meet acoustic requirements indicated.
5. Door Finish: Factory primed and field finished.
6. Sound Seals: Integral, concealed in door and/or frame.
7. Opening Force of Sound-Rated Doors, Non-Fire Rated: 5 lbs, maximum, in compliance with ADA Standards.

2.03 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
B. Frame Finish: Same as hollow metal door.
C. Exterior Door Frames: Full profile/continuously welded type.
   1. Frame Metal Thickness: 14 gage, 0.067 inch, minimum.
   2. Weatherstripping: Separate, see Section 08.71.00.
D. Interior Door Frames, Non-Fire Rated: Slip-on type at gypsum board walls, and knock-down type at masonry walls.
   1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
E. Door Frames, Fire-Rated: Slip-on type at gypsum board walls, and knock-down type at masonry walls.
   1. Fire Rating: Same as door, labeled.
   2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
F. Sound-Rated Door Frames: Slip-on type at gypsum board walls, and knock-down type at masonry walls.
   1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
G. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
H. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

2.04 ACCESSORIES

A. Louvers: Roll formed steel with overlapping frame; finish same as door components; factory-installed.
   1. In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.
   2. Style: Standard straight slat blade.
B. Glazing: As specified in Section 08.80.00, factory installed.
C. Grout for Frames: Portland cement grout with maximum 4 inch slump for hand troweling; thinner pumpable grout is prohibited.
D. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
E. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

2.05 FINISHES
A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify existing conditions before starting work.
B. Verify that opening sizes and tolerances are acceptable.
C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION
A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.
B. Coat inside of other frames with bituminous coating to a thickness of 1/16 inch.

3.03 INSTALLATION
A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
B. Install prefinished frames after painting and wall finishes are complete.
C. Install fire rated units in accordance with NFPA 80.
D. Coordinate frame anchor placement with wall construction.
E. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
F. Coordinate installation of hardware.
G. Coordinate installation of glazing.
H. Coordinate installation of electrical connections to electrical hardware items.
I. Touch up damaged factory finishes.

3.04 TOLERANCES
A. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

3.05 ADJUSTING
A. Adjust for smooth and balanced door movement.
B. Adjust sound control doors so that seals are fully engaged when door is closed.
C. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Flush wood doors; flush and flush glazed configuration; fire rated, non-rated, acoustical, and special function.

1.02 RELATED REQUIREMENTS
   A. Section 08.11.13 - Hollow Metal Doors and Frames.
   B. Section 08.80.00 - Glazing.
   C. Section 09.91.23 - Interior Painting: Field finishing of doors.

1.03 REFERENCE STANDARDS
   D. ASTM E413 - Classification for Rating Sound Insulation; 2010.
   G. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
   I. ITS (DIR) - Directory of Listed Products; current edition.
   K. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2016.
   L. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
   M. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS
   A. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
   B. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
      1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
      2. Include certification program label.
   C. Specimen warranty.
   D. Test Reports: Show compliance with specified requirements for the following:
      1. Sound-retardant doors and frames; sealed panel tests are not acceptable.
   E. Manufacturer's Installation Instructions: Indicate special installation instructions.
   F. Warranty, executed in Owner's name.
1.05 QUALITY ASSURANCE
A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
   1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
C. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
D. Quality Certification: Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
   1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) requirements for grade or grades specified.
   2. Provide designated labels on shop drawings as required by certification program.
   3. Provide designated labels on installed products as required by certification program.
   4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
E. Installed Fire Rated Door and Transom Panel Assembly: Conform to NFPA 80 for fire-rating as indicated.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Package, deliver and store doors in accordance with specified quality standard.
B. Accept doors on site in manufacturer's packaging. Inspect for damage.
C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.07 WARRANTY
A. See Section 01.78.00 - Closeout Submittals, for additional warranty requirements.
B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 DOORS
A. Doors: Refer to drawings for locations and additional requirements.
   1. Quality Level: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS).
   2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
   3. High Pressure Decorative Laminate (HPDL) Faced Doors: 5-ply unless otherwise indicated.
B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at all locations.
   2. Fire-Rated Doors: Tested to 20 minutes, 60 minutes, 90 minutes, and ratings as indicated on drawings in accordance with UL 10C - Positive Pressure; UL (DIR) or ITS (DIR) labeled without any visible seals when door is open.
   3. Sound Retardant Doors: Minimum STC of 35, calculated in accordance with ASTM E413, tested in accordance with ASTM E90.
4. Wood veneer facing for field transparent finish as indicated on drawings.
5. High pressure decorative laminate (HPDL) finish as indicated on drawings.

2.02 DOOR AND PANEL CORES
A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.
C. Sound Resistant Doors: Equivalent to type, with particleboard core (PC) construction with core as required to achieve STC rating specified; plies and faces as indicated above.

2.03 DOOR FACINGS
A. Veneer Facing for Transparent Finish: To be determined, veneer grade in accordance with quality standard indicated, quarter cut, with book match between leaves of veneer, balance match of spliced veneer leaves assembled on door or panel face.
B. Veneer Facing for Opaque Finish: Medium density overlay (MDO), in compliance with indicated quality standard.

2.04 DOOR CONSTRUCTION
A. Fabricate doors in accordance with door quality standard specified.
B. Cores Constructed with stiles and rails:
   1. Provide solid blocks at lock edge for hardware reinforcement.
   2. Provide solid blocking for other throughbolted hardware.
C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
   1. Exception: Doors to be field finished.
E. Provide edge clearances in accordance with the quality standard specified.

2.05 FACTORY FINISHING - WOOD VENEER DOORS
A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. System - 12, Polyurethane, Water-based.
      b. Sheen: Satin.
   2. Opaque:
      a. System - 12, Polyurethane, Water-based.
      b. Color: As selected by Architect.
      c. Sheen: Satin.

2.06 ACCESSORIES
A. Hollow Metal Door Frames: As specified in Section 08.11.13.
B. Glazed Openings:
   2. Fire-Protection-Rated Glass: Safety Certification, 16 CFR 1201, Category II.
   3. Tint: Clear.
C. Glazing Stops: Wood with metal clips for rated doors, butted corners; prepared for countersink style tamper proof screws.
D. Astragals for Non-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge.
E. Astragals for Fire-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge, specifically for double doors.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify existing conditions before starting work.
B. Verify that opening sizes and tolerances are acceptable.
C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION
A. Install doors in accordance with manufacturer's instructions and specified quality standard.
   1. Install fire-rated doors in accordance with NFPA 80 requirements.
   2. Install smoke and draft control doors in accordance with NFPA 105 requirements.
   3. Install exterior doors in accordance with ASTM E2112.
B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
C. Field-Finished Doors: Will not be allowed.
D. Use machine tools to cut or drill for hardware.
E. Coordinate installation of doors with installation of frames and hardware.
F. Coordinate installation of glazing.
G. Install door louvers plumb and level.

3.03 TOLERANCES
A. Conform to specified quality standard for fit and clearance tolerances.
B. Conform to specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING
A. Adjust doors for smooth and balanced door movement.
B. Adjust closers for full closure.

END OF SECTION 08.14.16
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Wall access door and frame units.
   B. Ceiling access door and frame units.

1.02 RELATED REQUIREMENTS
   A. Section 08.71.00 - Door Hardware: Mortise cylinder and core hardware.
   B. Section 09.91.13 - Exterior Painting: Field paint finish.
   C. Section 09.91.23 - Interior Painting: Field paint finish.

1.03 REFERENCE STANDARDS
   B. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.

1.04 SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
   C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
   D. Manufacturer's Installation Instructions: Indicate installation requirements.
   E. Project Record Documents: Record actual locations of each access unit.

1.05 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
   B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES
   A. Wall-Mounted Units:
      1. Material: Steel, hot-dipped zinc or zinc-aluminum-alloy coated.
      2. Size: 12 inch by 12 inch.
      3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
      4. Tool-operated spring or cam lock; no handle.
      5. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
   B. Wall-Mounted Units in Wet Areas:
      2. Size: 12 inch by 12 inch.
      3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
4. Tool-operated spring or cam lock; no handle.
5. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.

C. Fire-Rated Wall-Mounted Units:
1. Wall Fire-Rating: As indicated on drawings.
4. Door/Panel: Insulated double-surface panel, with tool-operated spring or cam lock and no handle.
5. Tool-operated spring or cam lock; no handle.

D. Ceilings, Unless Otherwise Indicated: Same type as for walls. Where a gypsum board ceiling greater than 120 square feet is not accessible provide a 24" x 24" access panel whether shown or not. Coordinate location with Mechanical.
1. Material: Steel.
2. Size - Lay-In Grid Ceilings: To match module of ceiling grid.
3. Size - Other Ceilings: 12 inch by 12 inch.
4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
5. Tool-operated spring or cam lock; no handle.

E. Fire-Rated Ceiling-Mounted Units:
4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
5. Tool-operated spring or cam lock; no handle.

2.02 WALL & CEILING-MOUNTED UNITS

A. Wall & Ceiling-Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
1. Style: Frame concealed by door panel.
2. Door Style: Single thickness with rolled or turned in edges.
3. Frames: 16 gage, 0.0598 inch, minimum thickness.
4. Heavy Duty Frames: 14 gage, 0.0747 inch, minimum thickness.
5. Single Steel Sheet Door Panels: 1/16 inch, minimum thickness.
6. Heavy Duty Single Steel Sheet Door Panels: 14 gage, 0.0747 inch, minimum thickness.
7. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
9. Primed and Factory Finish: Polyester powder coat; color as selected by Architect from manufacturer's standard colors.
10. Hardware:
   a. Hardware for Fire-Rated Units: As required for listing.
   b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.
B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
3.02 PREPARATION
A. Clean surfaces thoroughly prior to proceeding with this work.
B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION
A. Install units in accordance with manufacturer's instructions.
B. Install frames plumb and level in openings, and secure units rigidly in place.
C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION 08.31.00
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Overhead coiling doors, operating hardware, fire-rated, non-fire-rated, and exterior, manual and electric operation.
   B. Wiring from electric circuit disconnect to operator to control station.

1.02 RELATED REQUIREMENTS
   A. Section 07.92.00 - Joint Sealants: Sealing joints between frames and adjacent construction.
   B. Section 08.71.00 - Door Hardware: Cylinder cores and keys.
   C. Section 26.27.17 - Equipment Wiring: Power to disconnect.

1.03 REFERENCE STANDARDS
   C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
   D. ITS (DIR) - Directory of Listed Products; current edition.
   E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
   J. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS
   A. Product Data: Provide general construction, electrical equipment, and component connections and details.
   B. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
   C. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

1.05 QUALITY ASSURANCE
   A. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 COILING DOORS
   A. Exterior Coiling Doors: Steel slat curtain.
1. Capable of withstanding positive and negative wind loads of 20 psf, without undue deflection or damage to components.
2. Sandwich slat construction with insulated core of foamed-in-place polyurethane insulation; minimum R-value of 7.5 or greater.
3. Nominal Slat Size: 2 inches wide x required length.
5. Hood Enclosure: Manufacturer's standard; primed steel.

B. Non-Fire-Rated Interior Coiling Doors: Steel slat curtain.

C. Fire-Rated Coiling Doors: Steel slat curtain; conform to NFPA 80.
   1. 1-1/2 hour fire rating.
   2. Provide products listed and labeled by ITS (DIR) or UL (DIR) as suitable for the purpose specified and indicated.
   3. Oversized Openings: Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated units and operating hardware assembly.
   5. Guides: Angles; primed steel.
   6. Hood Enclosure: Manufacturer's standard; primed steel.
10. Locking Devices: Lock and latch handle on outside.

2.02 MATERIALS

A. Curtain Construction: Interlocking slats.
   1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
   2. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact in closed position.
   3. Weatherstripping: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.

B. Steel Slats: Minimum thickness, 22 gage, ___ inch ASTM A653/A653M galvanized steel sheet.

C. Guide Construction: Continuous, of profile to retain door in place with snap-on trim, mounting brackets of same metal.

D. Steel Guides: ASTM A36/A36M steel angles, size as required for wind loading, hot-dip galvanized per ASTM A 123/A 123M.

E. Hood Enclosure: Internally reinforced to maintain rigidity and shape.

F. Lock Hardware:
   1. For motor operated units, additional lock or latching mechanisms are not required.
   2. Latch Handle: Manufacturer's standard.
   3. Slide Bolt: Provide on single-jamb side, extending into slot in guides, with padlock on one side.

G. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.
2.03 ELECTRIC OPERATION

A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
   1. Provide interlock switches on motor operated units.

B. Electric Operators:
   1. Mounting: Side mounted.
   3. Motor Voltage: 208 volt, three phase, 60 Hz.
   5. Controller Enclosure: NEMA 250, Type 1.
   6. Opening Speed: 12 inches per second.

C. Control Station: Standard three button (OPEN-STOP-CLOSE) momentary control for each operator.
   1. 24 volt circuit.

D. Safety Edge: Located at bottom of curtain, full width, electro-mechanical sensitized type, wired to stop operator upon striking object, hollow neoprene covered.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

A. Install units in accordance with manufacturer's instructions.
B. Install fire-rated doors in accordance with NFPA 80.
C. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
D. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
E. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
F. Coordinate installation of electrical service with Section 26.27.17.
G. Complete wiring from disconnect to unit components.
H. Complete wiring from fire alarm system.
I. Install perimeter trim and closures.

3.03 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.
B. Maximum Variation From Plumb: 1/16 inch.
C. Maximum Variation From Level: 1/16 inch.
D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.04 ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.
3.05 CLEANING

A. Clean installed components.
B. Remove labels and visible markings.

END OF SECTION 08.33.23
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged power-operated door assemblies.
B. Operators for doors provided in other sections.
C. Controllers, actuators and safety devices.
D. Handrails adjacent to doors.
E. Maintenance.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS


1.04 SUBMITTALS

A. Shop Drawings: Indicate layout and dimensions; head, jamb, and sill conditions; elevations; components, anchorage, recesses, materials, and finishes, electrical characteristics and connection requirements.

B. Indicate installation tolerances required, assembly conditions, routing of service lines and conduit, and locations of operating components and boxes.

C. Product Data: Provide data on system components, sizes, features, and finishes.

D. Samples: Submit two samples of exposed to view hardware, carpet with frame, and attachment hardware.

E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and manufacturer's hardware and component templates.

F. Maintenance Contract.

G. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.

H. Maintenance Data: Include manufacturer's parts list and maintenance instructions for each type of hardware and operating component.

I. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Wrenches and other tools required for maintenance of equipment.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years of experience.

1.06 WARRANTY

A. Provide two year manufacturer warranty.
PART 2 PRODUCTS

2.01 POWER OPERATED DOORS

A. Power Operated Doors: Provide products that comply with the requirements of the authorities having jurisdiction; unless otherwise indicated, provide equipment selected for the actual weight of the doors and for light pedestrian traffic.
   1. Swinging Door Operators: Fully adjustable for opening and closing speeds, checking speeds, and hold-open time; in the event of power failure, disengage operator allowing door to function as a door with a spring closer.
   2. Packaged Door Assemblies: Provide all components by single manufacturer, factory-assembled, including doors, frames, operators, actuators, and safeties.

B. Swinging Doors with Low-Energy Power Operators: Comply with BHMA A156.19; operator activated by pushing or pulling the door or by a manual actuator, not a sensor; safeties not required.
   1. Kinetic Energy of Door in Motion: 1.25 pound-foot, maximum.
   2. Force Required to Prevent Stopped Door From Opening or Closing: 15 pounds-force, maximum, measured at 1 inch from the latch edge of the door at any point in the swing cycle.
   3. Force Required to Release Latch, if Any, When Unpowered: 15 pounds-force, maximum, measured at 1 inch from the latch edge of the door at any point in the swing cycle.
   4. Force Required to Set Door in Motion When Unpowered: 30 pounds-force, maximum, measured at 1 inch from the latch edge of the door at any point in the closing cycle.
   5. Force Required to Fully Open Door When Unpowered: 15 pounds-force, maximum, measured at 1 inch from the latch edge of the door at any point in the closing cycle.

C. Operators:
   2. Pneumatic/Hydraulic Operators: Low voltage control system, pneumatic activation to hydraulic device for opening and closing.

2.02 PACKAGED AUTOMATIC ENTRANCE DOOR ASSEMBLIES

A. Swinging Automatic Door: Single-acting hinged, electric operation, extruded aluminum glazed door, with extruded tubular frame, and operator concealed overhead.
   1. Operation: Low-energy power open, spring close operation.
   5. Provide handrails on both sides of each door leaf.
   6. Door and Frame Finish: Same as adjacent framing system.

2.03 OPERATORS FOR SWINGING DOORS PROVIDED BY OTHERS

A. Door Operator: Electric, surface mounted overhead.
   1. Operation: Low-energy power open, spring close operation.
   2. Variable speed control for opening and closing cycles.

2.04 CONTROLLERS, ACTUATORS, AND SAFETIES

A. Controller: Provide microprocessor operated controller for each door.
B. Comply with BHMA A156.10 for actuator and safety types and zones.
C. Push Button Actuator: Standard momentary contact type, wall mounted, surface; stainless steel escutcheon plate.

D. Swinging Door Safety Device: Door-mounted proximity detector device arranged to prevent operation of door when persons or obstructions are in the swing zone.

2.05 ACCESSORIES
   A. Steel Clips, Supports, and Steel Anchors: Galvanized to 1.25 ounces per square foot.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that surfaces are ready to receive work and dimensions are as indicated on shop drawings.
   B. Verify that electric power is available and is of the correct characteristics.

3.02 INSTALLATION
   A. Install equipment in accordance with manufacturer's instructions.
   B. Provide for thermal expansion and contraction of door and frame units and live and dead loads that may be transmitted to operating equipment.
   C. Provide for dimensional distortion of components during operation.
   D. Install pneumatic lines and door power units in a manner to prevent condensation or freezing.
   E. Coordinate installation of components with related and adjacent work; level and plumb.

3.03 ADJUSTING
   A. Adjust door equipment for correct function and smooth operation.

3.04 CLEANING
   A. Remove temporary protection, clean exposed surfaces.

3.05 CLOSEOUT ACTIVITIES
   A. Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.06 MAINTENANCE
   A. Provide a separate maintenance contract for specified maintenance service.
   B. Provide service and maintenance of operating equipment for one year from Date of Substantial Completion, at no extra charge to Owner.

END OF SECTION 08.42.29
100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
SECTION 08.43.13
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Aluminum-framed storefront, with vision glass.
   B. Aluminum doors and frames.
   C. Weatherstripping.
   D. Synthetic Marble Sillies
   E. Door hardware.

1.02 RELATED REQUIREMENTS
   A. Section 05.50.00 - Metal Fabrications: Steel attachment devices.
   B. Section 07.25.00 - Weather Barriers: Sealing framing to weather barrier installed on adjacent construction.
   C. Section 07.92.00 - Joint Sealants: Sealing joints between frames and adjacent construction.
   D. Section 08.42.29 - Automatic Entrances.
   E. Section 08.71.00 - Door Hardware: Hardware items other than specified in this section.
   F. Section 08.80.00 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS
   A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
   B. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; 2009.

1.04 ADMINISTRATIVE REQUIREMENTS
   A. Coordinate with installation of other components that comprise the exterior enclosure.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS
A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details.
C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
E. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
F. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
G. Report of field testing for water leakage.
H. Designer Qualifications Statement.
I. Manufacturer Qualifications Statement.
J. Installer Qualifications Statement.
K. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE
A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in Tennessee.
B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Handle products of this section in accordance with AAMA CW-10.
B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS
A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY
A. Correct defective Work within a five year period after Date of Substantial Completion.
B. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
C. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.
PART 2 PRODUCTS

2.01 STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices. Exterior frames shall be thermally broken.
   1. Glazing Rabbet: For 1 inch insulating glazing.
   3. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
   4. Finish: Class I natural anodized.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
   5. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   8. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
   9. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
  10. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements:
   1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
      a. Design Wind Loads: Comply with requirements of ASCE 7.
      b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
   2. Water Penetration Resistance: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.
   3. Air Leakage: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.
   4. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.

2.02 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.

B. Swing Doors: Glazed aluminum.

2.03 MATERIALS


B. Fasteners: Stainless steel.
C. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.04 SYNTHETIC MARBLE SILLS
   A. Provide sill material made from crystal marble stone that are bound by a natural acrylic resin. Sills shall be resistant to UV rays, acids, leaches and salts. The sills shall not absorb liquids. Material shall be suitable for exterior and interior use.
   B. Composition shall be 95% marble and 5% polyester acrylic resin.
   C. Color to be selected from manufacturer's standard color selections.

2.05 HARDWARE
   A. For each door, include weatherstripping, sill sweep strip, and threshold.
   B. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
   C. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.
   D. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify dimensions, tolerances, and method of attachment with other work.
   B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION
   A. Install wall system in accordance with manufacturer's instructions.
   B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
   C. Provide alignment attachments and shims to permanently fasten system to building structure.
   D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
   E. Provide thermal isolation where components penetrate or disrupt building insulation.
   F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
   G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
   H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
   I. Set thresholds in bed of sealant and secure.
   J. Install hardware using templates provided.
   K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES
   A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.
   B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
3.04 FIELD QUALITY CONTROL
   A. See Section 01.40.00 - Quality Requirements, for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.
   B. Test installed storefront for water leakage in accordance with AAMA 501.2 hose test.

3.05 ADJUSTING
   A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING
   A. Remove protective material from pre-finished aluminum surfaces.
   B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
   C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION
   A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 08.43.13
SECTION 08.44.13
GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Aluminum-framed curtain wall, with vision glazing and glass, metal, and stone infill panels.
B. Firestopping between curtain wall and edge of floor slab.

1.02 RELATED REQUIREMENTS
A. Section 05.12.00 - Structural Steel Framing: Steel attachment members.
B. Section 05.50.00 - Metal Fabrications: Steel attachment devices.
C. Section 07.25.00 - Weather Barriers: Sealing framing to weather barrier installed on adjacent construction.
D. Section 07.84.00 - Firestopping: Firestop at system junction with structure.
E. Section 07.92.00 - Joint Sealants: Sealing joints between frames and adjacent construction.
F. Section 08.42.29 - Automatic Entrances.
G. Section 08.43.13 - Aluminum-Framed Storefronts: Entrance framing and doors.
H. Section 08.80.00 - Glazing.

1.03 REFERENCE STANDARDS
A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
B. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; 2009.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Coordinate with installation of other components that comprise the exterior enclosure.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.
1.05 SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide component dimensions, describe components within assembly, anchorage and
      fasteners, internal drainage details, glazing, and infill.
   C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected
      related Work, expansion and contraction joint location and details, and field welding required.
   D. Shop Drawings: Provide details of proposed structural sealant glazing (SSG) and weather sealant joints
      indicating dimensions, materials, bite, thicknesses, profile, and support framing.
   E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
   F. Design Data: Provide framing member structural and physical characteristics and engineering
      calculations, and identify dimensional limitations; include load calculations at points of attachment to
      building structure.
   G. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the
      same design are acceptable.
   H. Field Quality Control Submittals: Report of field testing for water leakage.
   I. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and
      registered with manufacturer.

1.06 QUALITY ASSURANCE
   A. Designer Qualifications: Design structural support framing components under direct supervision of a
      Professional Structural Engineer experienced in design of this Work and licensed at Tennessee.
   B. Full-Size Mock-up Testing: Have a specimen representative of project conditions tested by an
      independent testing agency for compliance with specified thermal, structural, air infiltration, water
      penetration, and sound attenuation criteria.
   C. Verify that each component is appropriate for use in structural sealant glazing (SSG) application in
      regards to at least the following properties; size, shape, dimensions, material, self-life, storage conditions,
      and color.
   D. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section
      with not less than three years of documented experience.
   E. Installer Qualifications: Company specializing in performing work of type specified and with at least
      three years of documented experience.

1.07 MOCK-UP
   A. Locate on-site where directed by Architect. Mock-up may remain as part of the Work.
   B. Locate off-site where directed. Remove when directed.

1.08 DELIVERY, STORAGE, AND HANDLING
   A. Handle products of this section in accordance with AAMA CW-10.
   B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that
      bond to aluminum when exposed to sunlight or weather.

1.09 FIELD CONDITIONS
   A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum
      temperature during and 48 hours after installation.
1.10 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.
B. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
C. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 CURTAIN WALL

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Outside glazed, with pressure plate and mullion cover.
   2. Fabrication Method: Either shop/factory or field fabricated system.
   4. Vertical Mullion Face Width: 2-1/2 inches.
   6. Finish: Class I natural anodized.
      a. Factory finish surfaces that will be exposed in completed assemblies.
      b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
   7. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   9. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
   1. Design Wind Loads: Comply with the applicable code.
   2. Seismic Loads: Design and size components to withstand seismic loads and sway displacement in accordance with requirements of ASCE 7.
   3. Movement: Accommodate the following movement without damage to components or deterioration of seals:
      a. Expansion and contraction caused by 180 degrees F surface temperature.
      b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
      c. Movement of curtain wall relative to perimeter framing.
      d. Deflection of structural support framing, under permanent and dynamic loads.

C. Water Penetration Resistance: No uncontrolled water on indoor face when tested as follows:
   1. Test Pressure Differential: 10 psf.

D. Air Leakage: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.

E. Thermal Performance Requirements:
   1. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.
2.02 COMPONENTS
   A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
   B. Glazing: As specified in Section 08.80.00.

2.03 MATERIALS
   B. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.
   C. Firestopping: As specified in Section 07.84.00.
   D. Weatherseal Sealant: Silicone, with adhesion in compliance with ASTM C794; compatible with glazing accessories.
   E. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
   F. Glazing Accessories: As specified in Section 08.80.00.

2.04 FINISHES
   A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify dimensions, tolerances, and method of attachment with other related work.
   B. Verify that curtain wall openings and adjoining air and vapor seal materials are ready to receive work of this section.
   C. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION
   A. Install curtain wall system in accordance with manufacturer's instructions.
   B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
   C. Provide alignment attachments and shims to permanently fasten system to building structure.
   D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
   E. Provide thermal isolation where components penetrate or disrupt building insulation.
   F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
   G. Install firestopping at each floor slab edge.
   H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
   I. Pressure Plate Framing: Install glazing and infill panels in accordance with Section 08.80.00, using glazing method required to achieve performance criteria.
   J. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES
   A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 0.5 inches per 100 ft, whichever is less.
B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.04 FIELD QUALITY CONTROL
A. Provide services of manufacturer's field representative to observe installation and submit report.
B. Test installed curtain wall for water leakage in accordance with AAMA 501.2.
C. Replace curtain wall components that have failed field testing and retest until performance is satisfactory.

3.05 ADJUSTING
A. Adjust operating sash for smooth operation.

3.06 CLEANING
A. Remove protective material from pre-finished aluminum surfaces.
B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION
A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 08.44.13
100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
PART 1 GENERAL

1.01 SCOPE
   A. This is a high-performance aluminum window specification. The specification provides the Bidders with rigid standards for product materials, workmanship and performance that must be complied with in every respect.
   B. It is the intent of this specification to provide the Owner with proper product materials, workmanship, design, application performance, installation and warranty coverage. The specification describes specific test requirements, system performance, quality assurance tests, and product material requirements required to meet the Owner’s desired quality level.

1.02 WORK INCLUDED
   A. Furnish and install dual frame aluminum Thermo-Barrier windows with a perforated acoustical liner, complete with hardware, and related components as shown in drawings and specified in this Section.
   B. Basis of design is based upon DeVAC Series 600AL as manufactured by Mon-Ray, Inc. Other manufacturers requesting approval to bid their product must submit a request for approval 10 days prior to bid for consideration in accordance with section 01.25.13 Product Substitution Procedures.
   C. Windows to be horizontal sliding windows.

1.03 RELATED SECTIONS
   A. 07.92.00 - Joint Sealants
   B. 08.80.00 - Glazing

1.04 REFERENCES
   A. AAMA/NWWDA 101/I.S.2-97 “Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Sliding Glass Doors”
   B. AAMA 502 “Voluntary Specification for Field Testing of Windows and Sliding Glass Doors”
   C. ASTM E 90 “Laboratory Measurement of Airborne Sound Transmission of Building Partitions”
   D. ASTM E 283 “Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors”
   E. ASTM E 330 “Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference”
   F. ASTM E 331 “Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Air Pressure Difference”
   G. ASTM E 413 “Determination of Sound Transmission Class (STC)”

1.05 SYSTEM PERFORMANCE
   A. Performance Requirements: Windows will conform to AAMA/NWWDA 101/I.S.2-97 Sections 2.2.9 Fixed, 2.2.3 Vertical Sliding Windows 2.2.2 Horizontal Sliding Windows, and meet the optional designations F-C60, F-DW-C60, HS-DW-C60 and H-DW-C60 when tested in accordance with AAMA/NWWDA 101/I.S.2-97, Section 4, “Optional Performance Grades” for higher than minimum performance class. Each Bidder will submit test reports from Independent Testing Laboratories for each model being bid. Operating force and air leakage tests may be performed before water resistance testing. Unless a specific size dimension is noted in this specification, all window units tested by an independent laboratory shall have an overall frame size dimension not less than the following:
1. Fixed windows and removable panel dual windows: 5'0" (1.525 m) wide by 5'0" (1.525 m) high
2. Horizontal sliding dual windows: 5'11" (1.80 m) wide by 4'11" (1.50 m) high
3. Vertical sliding dual windows: 4'6" (1.37 m) wide by 7'6" (2.29 m) high

B. Air Leakage Test: The window shall be subjected to an air leakage test in accordance with ASTM E 283. Window units tested by an Independent Laboratory. Air leakage shall meet the following performance requirements;
   1. Air leakage for fixed windows shall not exceed 0.06 CFM (.028 l/s) per square foot at both a positive (infiltration) and negative (exfiltration) static pressure of 6.24 PSF (298.6 Pa) at 50 mph wind (80.46 kmph).
   2. With both of the interior sash in the closed and locked position and the exterior sash in the open position (Summer Mode), air leakage in removable panel, horizontal and vertical sliding windows shall not exceed 0.15 CFM (.07 l/s) per lineal foot of sash crack at both positive and negative static pressure of 1.56 PSF (74.6 Pa) at 25 mph wind (40.23 kmph) or 0.35 CFM (.165 l/s) per lineal foot of sash crack at a positive infiltration) static pressure of 6.24 PSF (298.6 Pa) at 50 mph wind (80.46 kmph). Windows with less than 18' (5.49 m) of sash crack shall not exceed 2.7 CFM (1.27 l/s) at 25 Mph (40.23 kmph). or 6.3 CFM (2.96 l/s) at 50 mph (80.46 kmph). total leakage.

C. Water Resistance Test:
   1. Summer Mode: With both of the interior sash in the closed and locked position and the exterior sash in an open position, the window shall be subjected to a water resistance test in accordance with ASTM E 331. When a positive static pressure of 8.0 PSF (382.8 Pa) at 56 mph wind (90.12 kmph) has been stabilized, 5 gallons (18.92 l) of water per hour per square foot of window area shall be applied to the exterior face of the window for a continuous period of 15 minutes. No water shall pass the interior face of the window frame. Windows tested by an independent laboratory shall be glazed with 1/8" (3.18 mm) clear annealed glass.
   2. Winter Mode: With both of the interior sash in the closed and locked position and the exterior sash in the closed and locked position, the window shall be subjected to a water resistance test in accordance with ASTM E 331. When a positive static pressure of 10.0 PSF (478.5 Pa) at 63 mph wind (101.4 kmph) has been stabilized, 5 gallons (22.7 l) of water per hour per square foot of window area shall be applied to the exterior face of the window for a continuous period of 15 minutes. No water shall pass the interior face of the window frame. Windows tested by an independent laboratory shall be glazed with 1/8" (3.18 mm) clear annealed glass.

D. Uniform Structural Load Test: With both of the interior sash in the closed and locked position and the exterior sash in an open position (Summer Mode), the window shall be tested in accordance with ASTM E 330. Optional class 60 for commercial grade windows. A minimum exterior positive and negative load of 90 PSF (4306.5 Pa) at 187 mph wind (300.9 kmph) shall be applied to fixed, removable panel, horizontal and vertical sliding windows. Each load shall be maintained for a period of 10 seconds. At the conclusion of these tests, there shall be no glass breakage, damage to fasteners, hardware or any other damage causing the window to be inoperable. There shall be no permanent deformation on any frame or sash member in excess of 0.5% of its span. Windows made to the AAMA/NWWDA laboratory test size for commercial grade windows requirements shall have the both sash glazed with 3/16" (4.8 mm) clear annealed glass for horizontal and vertical operating window and 1/4 (6.36 mm) glass for fixed and removable panel windows for this test.

E. Thermal Bridging Test: Using a battery powered continuity tester with probes that penetrate the window finish, there will be no electrical charge passing between the interior and exterior frame or sash members.

F. Operating Force Test: Operating sash once started in motion, will not require more than 20 LBS (9.08 kg) operating force for a horizontal sliding window and 35 LBS (15.87 kg) operating force for a vertical sliding window, to keep the sash in motion in either direction.

G. Deglazing Test: Operating sash will have no disengagement of the sash stiles and rails from the glass, when tested in accordance with ASTM E 987-88, when a load of 70 LBS (31.75 kg) is applied to the stiles of the horizontal sliding window and rails of the removable panel and vertical sliding windows and
a load of 50 LBS (22.7 kg) is applied to the rails of the horizontal sliding window and stiles of the removable panel and vertical sliding windows.

H. Thermal Performance (“U” Value) Test: When tested in accordance with AAMA 1503.1-88, a dual framed, aluminum thermal-barrier window with acoustical liner, glazed with 3/16” (4.8 mm) and 1/4” (6.3mm) clear annealed glass and having the overall frame sizes of either 4’ 0” by 6’ 0” (1.2m by 1.83 m) or 6’ 0” by 4’ 0” (1.83 m by 1.2 m) shall have a “U” value not exceeding .59.

I. Condensation Resistance Factor (CFR) Test: When tested in accordance with AAMA 1504-97 a dual framed, aluminum thermal-barrier window, glazed with 1/8” clear annealed glass and having the overall frame sizes of either 4’ 0” by 6’ 0” (1.2 m by 1.83 m) or 6’ 0” by 4’ 0” (1.83 by 1.2) shall have a CRF not less than 62.

J. Forced Entry Test: Windows shall pass a forced entry resistance of Grade 10.

K. Sound Transmission Test: When tested in accordance with ASTM E 90 “Laboratory Measurement of Airborne Sound Transmission of Building Partitions”, fixed, removable panel and operating windows measuring at least six square feet in overall frame size shall have a STC Rating not less than STC 50.

L. Aluminum Anodic Finish and Hardness Test: Prior to approval, the successful Bidder shall submit one (1) 12 inch long (30.5 cm) piece of anodically finished exterior window frame sill section. The Owner reserves the right to test this samples for coating thickness, coating weight, stain resistance and hardness. The performance will meet these minimums:
   1. ASTM E 244 (Anodized Coating thickness) .7 mils Architectural Class 1
   2. .4 mils Architectural Class 2
   3. ASTM B 137 (Anodic Coating Density) 38 g/in3
   4. ASTM B 680 (Anodic Seal Integrity) No observable stain

M. Rockwell Tester (Hardness) Gauge reading of at least 12 on Webster dial gauge

1.06 SUBMITTALS

A. Shop Drawings: Submit drawings under provisions of Section 01300. Include dimensions, relationships to construction of adjacent work, air and vapor barrier seal to adjacent construction, component anchorage, type of caulking, window locations, installation methods and installation materials. Dimensions of all windows and components will be the responsibility of the successful Bidder.

B. Samples: Submit appropriate color Samples for Architects review and approval.
   1. Color: One (1) 12 inch (30.5 cm) extrusion labeled with the specified finish.
   2. Glass: One (1) 12 inch (30.5 cm) square sample properly labeled for each glass type indicated.

C. Test Reports: Submit Independent Laboratory Test Reports verifying windows meet the specified requirements for air leakage, water resistance, uniform structural load, operating force, deglazing, thermal performance, condensation resistance factor, and sound transmission.

D. Certificates: Furnish an affidavit in triplicate from the Window Manufacturer, certifying that materials used on this Project conform to these Specifications and are identical in all appropriate respects to windows identified in the Independent Laboratory Test Reports.

1.07 QUALITY ASSURANCE

A. Qualifications: Fabrication shall be by a Window Manufacturer who can furnish evidence to the Owner that it is, and has been for not less than five (5) consecutive years, regularly engaged in the manufacturing of aluminum window units similar in design and performance to those specified for this Project.

B. Pre-award Installation:
   1. Provide a complete installation of one (1) window as specified and selected by the Owner. Window mock- up to be completed within seven (7) days of the bid opening date. This window and installation shall be for the review of the product and installation. The Owner at his discretion may
have the window tested by an Independent Test laboratory to verify compliance of the product with these Specifications. The cost for pre-award testing, by the Independent Laboratory shall be paid by Owner. Any deficiencies discovered on the window by the testing and the Bidder at no cost to the Owner will correct deficiencies in any similar models used in the project.

C. Post Installation Field Testing:
   1. The Owner will randomly select three windows after installation for field-testing.
   2. Window field-testing will be in accordance with AAMA 502-90 using Test Method B. After installation and before final payment, up to two percent (2%), but not less than two (2) window units may be randomly selected by the Owner and subjected to an air leakage and water resistance tests. Air leakage and water resistance test results shall meet the specified requirements. If any randomly tested window fails, the Successful Bidder shall make necessary corrections until satisfactory results are achieved and make corrections to all other window units installed as part of this Project.
   3. All costs associated with the Post Installation Field Testing and required repairs or replacements shall be borne by the Successful Bidder. These tests may be performed by either the Window Manufacturer’s technical service personnel using accurately calibrated and approved air leakage testing equipment, or by an approved Independent Test Laboratory. All tests shall be conducted in the presence of the Owner, or the Owner’s Representative.

D. Reference List:
   1. The Bidder shall furnish with its bid a Reference List from the Window Manufacturer containing not less than ten (10) completed projects with window units of similar to the window units specified for this Project. At least five (5) of the referenced projects shall be at least three (3) years old. As part of the bid evaluation to determine life cycle cost and best value for the Owner, consideration will be given as to age, longevity, performance and extended product life of these installations. The Reference List shall include the name, address and phone number of the project, and the date the project was completed.
   2. Also requested, is a list of five (5) projects, where the work consists of refurbishing similar aged models of those being bid.
   3. If an installation sub-contractor is used, the subcontractor must furnish a list of at least five (5) projects similar in scope to this project with the base bid.
   4. The Owner or Owners Representative has the right to deem the bidder as “non-responsible” or “non-qualified”, based upon inspection of any projects performed by the bidder as a contractor, sub-contractor or manufacturer, if the products or workmanship is determined to be unacceptable by the Owner or Owners Representative.

1.08 WARRANTY

A. Product Warranty: The successful Bidder shall furnish a positively written, non-prorated and fully transferable warranty from the Window Manufacturer against defects in materials and workmanship of the window units, under normal use, for a period of ten (10) years from the date of acceptance of the installed window units by the Owner. The warranty shall state that the Window Manufacturer shall provide all materials required to repair or replace defective materials or workmanship. The warranty shall further state that parts used to manufacture the window units, or suitable replacements, shall be available throughout the warranty period.

B. Installation Warranty: The Successful Bidder shall furnish a written warranty against defects in the installation workmanship and materials for a period of three (3) years from the date of acceptance by the Owner. Installation warranty work will be performed at no cost to the Owner.
PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS
   A. Basis of Design: Mon-Ray, Inc. (Manufacturer of DeVAC 600AL (600VB) Series Windows) 801 Boone Ave North
      Minneapolis, MN 55427-4432
      Phone: (800) 544-3646  Fax: (763) 546-8977  Website: www.monray.com

2.02 MATERIALS
   A. Aluminum: All aluminum sections shall be accurately extruded aluminum prime alloy 6063-T6. The minimum
      nominal wall thickness of all frame and sash members shall not be less than 0.062” (1.57 mm).
   B. Glazing: Glazing shall consist of 3/8” laminated glass inside and outside panes with 1” air space. Safety
      glazing shall be used as required by code and correctly labeled on glass. The glass shall be set into the
      sash stiles and rails with a wrap-around; flexible black vinyl glazing channel and all glazing channel
      voids at corners shall be internally sealed. All glass shall be factory washed.
   C. Weather-Strip: All weather-strip shall be silicone treated; UV stabilized polypropylene pile with an
      integral polypropylene fin running through the center. Weather-stripping shall be bonded to a
      non-shrinking backing, which shall slide into extruded ports in the aluminum frame and sash. All
      weather-strip shall be staked in place.

2.03 WINDOW TYPE AND OPERATION
   A. Type: All windows shall be horizontal sliding aluminum, dual framed, Thermo-Barrier windows with an
      acoustical liner. For standard windows the frame depth shall be 6 11/16” (17.0 cm). All removable and
      operating glass sash and screen inserts shall be easily removable to the interior for cleaning.
   B. Operation: Operating sash and frame surfaces to be completely separated from metal-to-metal contact. All
      horizontal sliding sashes shall operate smoothly and within specified operating force on 1 1/2” x 1/4” x
      5/8” (3.81 cm x .63 cm by 1.59 cm) durable nylon blocks securely concealed in the bottom sash rails,
      which glide on raised sash tracks of sill frame. All vertical-sliding sashes shall operate on spring loaded
      nylon cushion blocks, incorporating a stainless steel, nylon tipped pin-lock. The pin-locks shall engage
      automatically into predetermined ventilating positions processed into each of the side jamb frames.

2.04 HARDWARE
   A. All assembly and installation fasteners and screws incorporated in the window units, exterior panning and
      interior trim shall be non-magnetic, stainless steel. All hardware parts shall be of aluminum, stainless
      steel, nylon, or other non-corrosive materials compatible with aluminum. NOTE: Wrought metal or
      plastic parts will not be acceptable.
   B. Meeting rail locks shall be constructed of extruded 6063-T6 aluminum with a permanent black anodized
      finish. The lock shall be spring-loaded to provide automatic locking in the closed position.
   C. All removable panel and vertical sliding sash shall remove using spring-loaded nylon cushion blocks,
      incorporating a stainless-steel pin-lock assembly. The pin-lock assemblies in vertical sliding sash shall
      automatically engage in predetermined ventilation holes processed into the frame.
   D. All horizontal sliding windows will be fitted with a sash retainer at the meeting rail to prevent the sash or
      screen from being removed or pushed to the exterior beyond the plane of the window. An optional
      “Anti-Tip” device is available to assure smooth operation of tall and narrow horizontal sliding sash.
   E. All operating sash exceeding 20 LBS (9.1 kg) in weight in vertical sliding (double-hung) windows will be
      equipped with overhead mounted block-and-tackle, spring-loaded balances. Non-operating, removable
      upper sash exceeding 20 LBS (9.1) in weight in vertical sliding windows shall be blocked in the closed
      position by removable sash block installed into the sash track.
F. Optional sash restrictors are available to restrict sash operation to any desired opening size. Sash restrictors keep operating sash in horizontal sliding and vertical sliding windows from being fully opened from either the interior or exterior.

2.05 FABRICATION

A. Frame and Sash Construction:
   1. Frame: All frame members to be extruded 6063-T6 aluminum. Frame corners to be butt type, with permanent cross-linked polyethylene gasket corners, secured with #8 x 5/8” (15.8 mm) non-magnetic stainless steel screws into integral screw ports. All sill members to be tubular construction with a positive five-degree uninterrupted continuous slope to the exterior for drainage. The sill shall be fastened to the jambs with eight (8) # 8 x 5/8” (15.8 mm) non-magnetic stainless steel screws. The head shall be fastened to the jams with four (4) # 8 x 5/8” (15.8 mm) non-magnetic stainless steel screws. Sills to have a 3/4” (19.05 mm) monorail” leg for the sash to ride upon, with a minimum of 3/8” (9.5 mm) sash clearance from the sill base. All sash to frame perimeter will be double weather-striped. All weather-stripping shall be installed in extruded ports and staked in place to prevent movement.
   2. Sash: All sash members shall be extruded 6063-T6 aluminum. All meeting rail and jamb stile members shall be tubular aluminum extrusions. Full length extruded pull or lift rails shall be a minimum 3/16” (4.8 mm) thick and protruding 3/4” (19.05 mm) from the face of the extrusion. Sash corners to be butt-type, joined in a weather tight manner using four (4) #6 x 1 1/4” (31.75 mm) leader type non-magnetic stainless steel screws into integral screw ports. Corner joints to be factory processed with a sealant hole at each corner that allow filling of the corners with sealant to create a watertight seal. All meeting rails shall interlock and be double weather- stripped. Glazing shall be held in place by a wrap-around virgin vinyl glazing installed in one continuous piece with the splice at the top of the glass. Replacement of the glass must be accomplished in a timely manner and reassembly must be capable of re-use of the original vinyl glazing with the restoration to the original weather tight seal.
   3. Perforated Aluminum Acoustical Liner: Interior and exterior frames and sashes are separated by an intermediate perimeter framing system. This system houses a sound abatement acoustic foam enclosed in a perforated extruded aluminum snap-on cover. Glass to glass air space shall be 4 5/8” (11.75 cm)

B. Weep System: The sill weep system shall be designed and constructed to prevent the infiltration of air, dirt and insects from the outside to the interior, and provide ample opening relative to the window size, to prevent the accumulation of water and not rely on sponge blocks. Both the interior and exterior sill frames shall have four (4) 2” x 1/4” (50.8 mm x 6.3 mm) weep slots with four (4) 5” (12.7 cm) weep flaps to cover the slots. Weep flaps shall be of extruded aluminum matching the window finish of the frame and be attached into recessed integrally extruded ports allowing for free flap movement. Weep flaps shall be counter-balanced and gravity operated, opening to exhaust water and closing to help prevent air-leakage and infiltration of insects.

C. Thermal-Break: The thermal-break shall be a non-structural barrier, connecting the entire adjacent perimeters of the interior and exterior aluminum frames. The thermal-break shall accomplish the following objectives:
   1. Design: The thermal-break shall insulate the exterior frame from the interior frame by providing resistance to heat flow. The interior and exterior frames shall interlock together with a continuous rigid PVC extrusion, surrounded by an extruded aluminum “box” housing, which is an integral part of the interior frame members. The exterior frame members will have an integrally extruded aluminum “T” connector, which shall slide into the rigid PVC extrusion. The design shall only subject the thermal-break to compressive stress. Double Thermo-BARRIER (DT) windows shall incorporate two (2) Thermo-Barrriers.
   2. Thermal Movement: The thermal-break shall allow for free linear movement between the interlocking thermal- break and the separate aluminum members to accommodate expansion and
contraction. The temperature range shall be -30°F to +180°F (-36°C to 82.2°C) to at exterior (metal
temperatures), with a +70°F (21°C) indoor air temperature. No screws, clips or metal straps will
bridge the thermal-break or restrict the independent expansion or contraction of the frame members.

3. Thermal Break Protection: A separate continuous bead of urethane caulking shall completely seal
the exposed surface area of the thermal-break between interior and exterior frames. The
thermal-break surface area at the sill shall provide a continuous slope between the interior and
exterior sill frame members to prevent accumulation of water on the sealant. NOTE: Use of
structural poured and debridged polyurethane and structural slide-in thermal-breaks of any kind will
not be acceptable.

2.06 FINISHES
A. Anodic (Anodized Finish)
1. Finish all areas of aluminum windows and components with electrolytically deposited color in
accordance with the following Aluminum Association Designation:
2. AA Designation and color to be AA-M10-C22-A31/41, Class II, Clear Anodized

2.07 ACCESSORIES
A. Interior Trim: All interior trim shall be 6063-T6 extruded aluminum with a minimum nominal wall
thickness of .05” (1.27 mm). Interior trim shall be installed around the interior perimeter of the window
opening as shown in the Project drawings with hidden mounting clips and fasteners.
1. NOTE: Exposed screw heads or rivets shall not be acceptable.
B. Mullions and Transoms: Where two or more frames are joined together, horizontally or vertically, the
mullion or transom connector shall continuously interlock onto the inner and outer edges of the adjacent
window frames and incorporate a port for weather-sealing at the exterior. Exposed screw heads or rivets
on either the interior or the exterior exposed surfaces of mullions or transoms shall not be acceptable. The
mullions and transoms shall be capable of withstanding the project design wind load (positive and
negative) on the total area without deflecting more than 1/175th of the span.

PART 3 EXECUTION

3.01 EXAMINATION
A. Bidders are expected to visit the job-site and make a complete survey of the Project prior to bid. The
Bidder for proper sizing of the new windows will measure all window openings. Failure to do so will not
relieve the Successful Bidder from the need to furnish all materials, which may be required, in accordance
with the Specifications, without any additional cost to the Owner.
B. Inspect openings before installation to assure surfaces are clean and dry. Verify that rough opening and
masonry openings are correct and the sill plate is level.

3.02 PREPARATION
A. Remove new window units from crating and packaging material. Verify that all parts and accessories are
included. All window units and accessories shall be securely stored, upright and protected from the
weather.
1. Remove old windows and accessories from the window opening. Scrape and remove existing
sealant from the opening, which will interfere with the installation of new windows.
2. Install only preservative treated lumber, as required, for all liners and blocking. All liners,
sub-framing or new framing shall be the full length of the head, jambs and sill. The shimming
surfaces will be of adequate depth to shim the entire depth of the new window frame
3. Caulking shall be a one-part non-sag polyurethane sealant (Type II Class A).
B. INSTALLATION
1. Windows shall be installed in strict accordance with the Manufacturer’s instructions and Shop Drawings.
2. Plumb and align window faces in a single plane for each wall plane. Erect windows and accessories square and true, using shims and anchors to maintain a permanent position.
3. Anchors should be not less than #10 non-magnetic, stainless steel screws. The length of the installation screws shall allow a minimum of one (1) inch (2.54 cm) to penetrate through any liners or blocking into the existing window frame or new sub-framing. Anchors shall be installed through both the interior and exterior frames. Anchoring screws will be countersunk into the main frames to avoid any interference with sash, balances or hardware. Anchoring through the tubular interior or exterior sill frames shall not be acceptable. Anchors must be adequate to handle thermal and building movement, and specified uniform load requirements.

C. ADJUST AND CLEAN
1. Operate installed windows to assure a proper installation has occurred. Make any appropriate adjustments.
2. Remove excess sealant, dirt, window labels and wipe dust off frame and glass.

END OF SECTION 08.58.00
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for wood, aluminum, and hollow metal doors.
B. Hardware for fire-rated doors.
C. Lock cylinders for doors that hardware is specified in other sections.
D. Thresholds.
E. Weatherstripping, seals and door gaskets.

1.02 RELATED REQUIREMENTS

A. Section 08.11.13 - Hollow Metal Doors and Frames.
B. Section 08.14.16 - Flush Wood Doors.
C. Section 08.32.00 - Sliding Glass Doors: Hardware for same, except cylinders; installation of cylinders.
D. Section 08.33.23 - Overhead Coiling Doors: Lockable coiling doors.
E. Section 08.42.29 - Automatic Entrances: Hardware for same except cylinders; installation of cylinders.
F. Section 08.42.29 - Automatic Entrances: Power operators.

1.03 REFERENCE STANDARDS

B. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches; 2011.
C. BHMA A156.3 - American National Standard for Exit Devices; 2014.
D. BHMA A156.4 - American National Standard for Door Controls - Closers; 2013.
E. BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks; 2014.
F. BHMA A156.6 - American National Standard for Architectural Door Trim; 2010.
G. BHMA A156.7 - American National Standard for Template Hinge Dimensions; 2014.
H. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; 2010.
J. BHMA A156.18 - American National Standard for Materials and Finishes; 2012.
N. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; 1993; also in WDHS-1/WDHS-5 Series, 1996.
P. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware will be installed upon.
B. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
C. Convey Owner's keying requirements to manufacturers.
D. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; require attendance by all affected installers.
E. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

A. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project.
B. Hardware Schedule: Detailed listing of each item of hardware to be installed on each door. Use door numbering scheme as included in the Contract Documents. Identify electrically operated items and include power requirements.
C. Keying Schedule: Submit for approval of Owner.
D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
E. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1.06 QUALITY ASSURANCE

PART 2 PRODUCTS

2.01 DOOR HARDWARE - GENERAL

A. Provide hardware specified or required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated. Meet ETSU standards for all hardware.
B. Provide items of a single type of the same model by the same manufacturer.
C. Provide products that comply with the following:
   1. Applicable provisions of federal, state, and local codes.
   3. Hardware on Fire-Rated Doors, Except Hinges: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.
D. Finishes: Provide door hardware of the same finish unless otherwise indicated.
   1. Primary Finish: Satin chrome plated over nickel on brass or bronze, 626 (approx US26D).
   2. Secondary Finish: Satin chrome plated over nickel on brass or bronze, 626 (approx US26D).
   3. Finish Definitions: BHMA A156.18.
   4. Exceptions:
      a. Where base metal is specified to be different, provide finish that is an appearance equivalent according to BHMA A156.18.
E. Fasteners:
   2. Concrete and Masonry Substrates: Stainless steel machine screws and lead expansion shields.
2.02 LOCKS AND LATCHES
A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
   1. If no hardware set is indicated for a swinging door provide an office lockset.
   2. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.
   3. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.
B. Electrically Operated Locks: Fail secure unless otherwise indicated.
C. Lock Cylinders: Manufacturer’s standard tumbler type, seven-pin interchangeable core.
   1. Provide cams and/or tailpieces as required for locking devices required.
D. Keying: Grand master keyed.
E. Latches: Provide a latch for every door that is not required to lock, unless specifically indicated "push/pull" or "not required to latch".

2.03 HINGES
A. Hinges: Provide hinges on every swinging door.
   1. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
   2. Provide ball-bearing hinges at all doors.
   3. Provide hinges in the quantities indicated.
   4. Provide non-removable pins on exterior outswinging doors.
   5. Where electrified hardware is mounted in door leaf, provide power transfer hinges.
B. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7; standard weight, unless otherwise indicated.
   1. Provide hinge width required to clear surrounding trim.
C. Quantity of Hinges Per Door:
   1. Doors up to 60 inches High: Two hinges.
   2. Doors From 60 inches High up to 90 inches High: Three hinges.
   3. Doors 90 inches High up to 120 inches High: Four hinges.
   4. Doors over 120 inches High: One additional hinge per each additional 30 inches in height.
D. Manufacturers - Hinges:
   4. Substitutions: See Section 01.60.00 - Product Requirements.

2.04 PUSH/PULLS
A. Push/Pulls: Comply with BHMA A156.6.
   1. Provide push and pull on doors not specified to have lockset, latchset, exit device, or auxiliary lock.
   2. On solid doors, provide matching push plate and pull plate on opposite faces.
   3. On glazed storefront doors, provide matching push/pull bars on both faces.
B. Manufacturers - Push/Pulls:
   1. Ives #8200 and #8302: 6" x 16", 626 or 26D.

2.05 CYLINDRICAL LOCKSETS
A. Locking Functions: As defined in BHMA A156.2, and as follows.
   1. Passage: No locking, always free entry and exit.
   2. Privacy: F76, emergency tool unlocks.
   3. Office: F82 Grade 1, key not required to lock, unlocks upon exit.
4. Classroom: F84, key required to lock.
5. Intruder Classroom: F110, keyed both sides.
6. Communicating: F80 or F113.
7. Two-Key Entry: F88, outside locked by key from both sides, free egress
8. Exit Only: F89, may not be left unlocked.

B. Manufacturers - Cylindrical Locksets:

2.06 MORTISE LOCKSETS
A. Locking Functions: As defined in BHMA A156.13, and as follows:
   1. Passage: F01.
   2. Office: F04, key not required to lock, remains locked upon exit.
   3. Classroom: F05, key required to lock.
   4. Communicating: F03, deadbolts operated independently from each side, not an exit.
   5. Entry, Deadbolt: F20, may be locked without key, free egress.
   6. Store Door: F14, deadbolt locked by key from both sides, not an emergency exit (must be unlocked during occupied hours).
   7. Exit Only: F07 or F31, may have outside trim, may not be left unlocked.

B. Manufacturers - Mortise Locksets:

2.07 CYLINDERS FOR LOCKSETS
A. Manufacturer: Corbin-Russwin 8000 Interchangable Core; www.assaabloydss.com.

2.08 PUSH PAD LOCKSETS
A. Manufacturer: Simplex Kaba L-1000
   1. Provide interchangable core
   2. 626 or 26D finish

2.09 AUXILIARY LOCKS (DEADBOLTS)
A. Locking Functions: As defined in BHMA A156.5, and as follows:
   1. Deadbolt, Classroom: E017.
   2. Public Entry/Exit ("Nightlatch"): E023, D012
   3. Deadbolt, Unoccupied: E015 or F17, deadbolt by key outside and turn inside.
   4. Deadbolt, Classroom, Unoccupied: E010 or F18, deadbolt by key outside.

B. Manufacturers - Auxiliary Locks (Deadbolts): Same as other locks.

2.10 FLUSHBOLTS AND COORDINATORS
A. Flushbolts: Lever extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.
   1. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
   2. Floor Bolts: Provide dustproof strike except at metal thresholds.

B. Manufacturers - Flushbolts:

2.11 ELECTRONIC LOCKSETS WITH CARD ACCESS
A. Manufacturer - Electronic Locksets with Card Access
2.12 ELECTRONIC ACCESS WITH CARD
A. Equal to CBord Network Controlled.

2.13 EXIT DEVICES
A. Locking Functions: Functions as defined in BHMA A156.3, and as follows:
   1. Entry/Exit, Always-Unlocked: Outside lever unlocked, no outside key access, no latch holdback.
   2. Entry/Exit, Free Swing: Key outside retracts latch, latch holdback (dogging) for free swing during occupied hours, not fire-rated; outside trim must be specified as lever or pull.
   3. Entry/Exit, Always-Latched: Key outside locks and unlocks lever, no latch holdback (dogging).
   4. Exit Only, Secure: No outside trim, no key entry, no latch holdback, deadlocking latchbolt.
B. Manufacturers - Exit Devices:
      a. Devices shall be ADA compliant.

2.14 ELECTRONIC EXIT DEVICES
A. Manufacturer: Von Duprin; 98/98 series.
   1. Devices shall be ADA compliant.

2.15 CLOSERS
A. Closers: Complying with BHMA A156.4.
   1. Provide surface-mounted, door-mounted closers unless otherwise indicated.
   2. Provide a door closer on every exterior door.
   3. Provide a door closer on every fire- and smoke-rated door. Spring hinges are not an acceptable self-closing device unless specifically so indicated.
   4. On pairs of swinging doors, if an overlapping astragal is present, provide coordinator to ensure the leaves close in proper order.
B. Manufacturers - Surface Mounted Closers:

2.16 STOPS AND HOLDERS
A. Stops: Complying with BHMA A156.8; provide a stop for every swinging door, unless otherwise indicated.
   B. Floor Stops: dome shaped.
   C. Manufacturers - Wall and Floor Stops/holders:
      4. Substitutions: See Section 01.60.00 - Product Requirements.

2.17 GASKETING AND THRESHOLDS
A. Gaskets: Complying with BHMA A156.22.
   1. On each door in smoke partition, provide smoke gaskets; top, sides, and meeting stile of pairs. If fire/smoke partitions are not indicated on drawings, provide smoke gaskets on each door identified as a "smoke door" and 20-minute rated fire doors.
   2. On wood doors with fire rating more than 20-minutes, provide frame-applied intumescent gaskets.
3. On each exterior door, provide weatherstripping gaskets, unless otherwise indicated; top, sides, and meeting stiles of pairs.
   a. Where exterior door is also required to have fire or smoke rating, provide gaskets functioning as both smoke and weather seals.
4. On each exterior door, provide door bottom sweep, unless otherwise indicated.
5. On doors indicated as "sound-rated", "acoustical", or with an STC rating, provide sound-rated gaskets and automatic door bottom; make gaskets completely continuous, do not cut or notch gaskets for installation.

2.18 PROTECTION PLATES AND ARCHITECTURAL TRIM
   A. Protection Plates:
      1. Kickplate: Provide on push side of every door with closer, except aluminum storefront and glass entry doors.
   B. Manufacturers - Protection Plates and Architectural Trim:
      1. Ives; #8400; 8” high x length required, 626 or 26D; www.professional.iveshardware.com

2.19 KEY CONTROLS
   A. Key Management System: For each keyed lock on project, provide one set of consecutively numbered duplicate key tags with hanging hole and snap catch.
      1. Security Key Tags: For each keyed lock on project, provide one set of matching key tags for permanent attachment to one key of each set.
      2. Provide key collection envelopes, receipt cards, and index cards in quantity suitable to number of keys to be managed.
   B. Facility Manager's Key Cabinet: Sheet steel construction, piano hinged door with key lock.
      2. Capacity: Actual quantity of keys, plus 25 percent additional capacity.
      3. Size key hooks to hold 6 keys each.
      5. Key cabinet lock to building keying system.

2.20 FIRE DEPARTMENT LOCK BOX
   A. Fire Department Lock Box: Heavy-duty, recessed, solid stainless-steel box with hinged door and interior gasket seal; single drill resistant lock with dust covers and tamper alarm.
      2. Finish: Manufacturer's standard black.
   B. Manufacturers - Fire Department Lock Box:
      2. Substitutions: See Section 01.60.00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that doors and frames are ready to receive work; labeled, fire-rated doors and frames are present and properly installed, and dimensions are as indicated on shop drawings.
   B. Verify that electric power is available to power operated devices and of the correct characteristics.

3.02 INSTALLATION
   A. Install hardware in accordance with manufacturer's instructions and applicable codes.
   B. Use templates provided by hardware item manufacturer.
C. Install hardware on fire-rated doors and frames in accordance with code and NFPA 80.

D. Mounting heights for hardware from finished floor to center line of hardware item.
   1. For steel doors and frames: Comply with DHI (LOCS) "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames".
   2. For Wood Doors: Comply with DHI WDHS.3 "Recommended Locations for Architectural Hardware for Flush Wood Doors".

E. Set exterior door thresholds with full-width bead of elastomeric sealant on each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.03 FIELD QUALITY CONTROL
   A. Provide an Architectural Hardware Consultant to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.04 ADJUSTING
   A. Adjust work under provisions of Section 01.70.00 - Execution and Closeout Requirements.
   B. Adjust hardware for smooth operation.
   C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.05 CLEANING
   A. Clean adjacent surfaces soiled by hardware installation. Clean finished hardware per manufacturer's instructions after final adjustments has been made. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.06 PROTECTION
   A. Protect finished Work under provisions of Section 01.70.00 - Execution and Closeout Requirements.
   B. Do not permit adjacent work to damage hardware or finish.

3.07 SCHEDULE - TO BE DETERMINED. FOR DESIGN DEVELOPMENT PRICING ALLOW $1,000.00 PER DOOR LEAF.

END OF SECTION 08.71.00
100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Insulating glass units.
   B. Glazing units.
   C. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS
   A. Section 06.41.00 - Architectural Wood Casework: Cabinets with requirements for glass shelves.

1.03 REFERENCE STANDARDS
   M. GANA (GM) - GANA Glazing Manual; 2009.

1.04 ADMINISTRATIVE REQUIREMENTS
   A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.
1.05 SUBMITTALS
A. Product Data on Insulating Glass Unit, Glazing Unit, Plastic Sheet Glazing Unit, and Plastic Film Glazing
   Types: Provide structural, physical and environmental characteristics, size limitations, special handling
   and installation requirements.
B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental
   characteristics, limitations, special application requirements. Identify available colors.
C. Certificate: Certify that products of this section meet or exceed specified requirements.
D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in
   Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE
A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000
   for glazing installation methods. Maintain one copy on site.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this
   section with minimum three years of documented experience.
C. Installer Qualifications: Company specializing in performing work of the type specified and with at least
   three years documented experience.
D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of
   the type specified in this section.

1.07 FIELD CONDITIONS
A. Do not install glazing when ambient temperature is less than 40 degrees F.
B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing
   compounds.

1.08 WARRANTY
A. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure,
   interpane dusting or misting, including replacement of failed units.
B. Laminated Glass: Provide a five (5) year manufacturer warranty to include coverage for delamination,
   including replacement of failed units.

PART 2 PRODUCTS
2.01 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES
A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to
   withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and
      maximum lateral deflection of supported glass.
   2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass
      edges to less than 1/175 of their lengths under specified design load.
   3. Glass thicknesses listed are minimum.
B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building
   enclosure vapor retarder and air barrier.
   1. In conjunction with vapor retarder and joint sealer materials described in other sections.
C. Thermal and Optical Performance: Provide glass products with performance properties as indicated.
   Performance properties are in accordance with manufacturer's published data as determined with the
   following procedures and/or test methods:
1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.

D. All southern exterior exposed glass performance shall be equal to Solarban 70XL Solar Control Low-e glass. All other exterior exposed glass performance shall be equal to Solarban 60. All glass shall be clear in color.

E. All glazing in sound rated walls shall be laminated three layer system designed to decouple and disseminate sound waves in the 1,000 to 3,000 Hz range.

2.02 GLASS MATERIALS
A. Float Glass: Provide float glass based glazing unless noted otherwise.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality-Q3.
   2. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and FT.
   3. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality-Q3, color and performance characteristics as indicated.
   4. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
   1. Laminated Safety Glass: Complies with ANSI Z97.1 and 16 CFR 1201 test requirements for Category II.
   2. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch thick, minimum.

2.03 INSULATING GLASS UNITS
A. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
   3. Metal Edge Spacers: Aluminum, bent and soldered corners.
   5. Edge Seal:
      a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone or polyurethane sealant as secondary seal applied around perimeter.
   7. Purge interpane space with dry air, hermetically sealed.

B. Type IG-1 - Insulating Glass Units: Vision glass, double glazed.
   1. Applications: Exterior glazing unless otherwise indicated.
   2. Space between lites filled with argon.
   3. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
      a. Tint: Clear.
      b. Coating: Low-E (passive type), on #2 surface.
   4. Inboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
      a. Tint: Clear.
   5. Total Thickness: 1 inch.
   6. Thermal Transmittance (U-Value): 0.35, nominal.
   8. Solar Heat Gain Coefficient (SHGC): 0.62 percent, nominal.

C. Type IG-2 - Insulating Glass Units: Vision glass, double glazed.
   1. Applications: Exterior glazing unless otherwise indicated. Use on southern exposure of facility.
   2. Space between lites filled with argon.
   3. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
      a. Tint: Clear.
      b. Coating: Low-E (passive type), on #2 surface.
   4. Inboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
      a. Tint: Clear.
   5. Total Thickness: 1 inch.

D. Type IG-3 - Vision glass, double glazed, acoustic.
   1. Exterior glazing for all Music Faculty Offices, Instrumental Rehearsal, Percussion Rehearsal, and Choral Rehearsal. 1” insulating glass: 1/4” laminated glass, 1/2” space filled with argon, 1/4” laminated glass. Low-E (passive type) coating on #2 surface.
   2. Thermal Transmittance (U-Value): 0.26, nominal.
   4. Solar Heat Gain Coefficient (SHGC): 0.27 percent, nominal.
   5. Visible Light Reflectance, Outside: 12 percent, nominal.

2.04 GLAZING UNITS

A. Monolithic Interior Vision Glazing:
   1. Applications: Interior glazing unless otherwise indicated.
   2. Glass Type: Fully tempered float glass.
   3. Tint: Clear.
   4. Thickness: 1/4 inch, nominal.

B. Sound Control Glazing: Laminated double insulating glass.
   1. Applications: Locations as indicated on drawings.
   2. Tint: Clear.
   4. Overall Thickness: As required to meet STC rating as indicated.
   5. Laminated Double Insulating Glass:
      a. Outer Layer, Outboard Side: Annealed glass.
         1) Thickness: 3/16 inch.
      b. Interlayer: Polyvinyl butyral (PVB), thickness as required to meet performance criteria.
      c. Outer Layer, Inboard Side: Annealed glass.
         1) Thickness: 3/16 inch.
      d. Air Space: 1/2 inch, filled with air.
      e. Inner Layer, Outboard Side: Annealed glass.
         1) Thickness: 1/4 inch.
      f. Interlayer: Polyvinyl butyral (PVB), thickness as required to meet performance criteria.
      g. Inner Layer, Inboard Side: Annealed glass.
         1) Thickness: 1/4 inch.

2.05 GLAZING COMPOUNDS

A. Glazing Putty: Polymer modified latex recommended by manufacturer for outdoor use, knife grade consistency; grey color.

B. Butyl Sealant: Single component; ASTM C920, Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.
C. Polyurethane Sealant: Single component, chemical curing, non-staining, non-bleeding; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 20 to 35; color as selected.

D. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

2.06 ACCESSORIES
A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Continuous x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
   1. Width: As required for application.
   2. Thickness: As required for application.
D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.
E. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION
3.01 VERIFICATION OF CONDITIONS
A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
B. Verify that the minimum required face and edge clearances are being provided.
C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
D. Verify that sealing between joints of glass framing members has been completed effectively.
E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION
A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL
A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)
A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 INSTALLATION - WET/DRY GLAZING METHOD (PREFORMED TAPE AND SEALANT)
A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.
B. Cut glazing tape to length and set against permanent stops, 3/16 inch below sight line. Seal corners by butting tape and dabbing with butyl sealant.
C. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.
D. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
E. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.
F. Install removable stops, with spacer strips inserted between glazing and applied stops 1/4 inch below sight lines.
   1. Place glazing tape on glazing pane of unit with tape flush with sight line.

3.06 INSTALLATION - WET/DRY GLAZING METHOD (TAPE AND SEALANT)
A. Application - Interior Glazed: Set glazing infills from the interior of the building.
B. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.
C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
D. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
E. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.
F. Carefully trim protruding tape with knife.

3.07 FIELD QUALITY CONTROL
A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
B. Monitor and report installation procedures and unacceptable conditions.

3.08 CLEANING
A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
B. Remove non-permanent labels immediately after glazing installation is complete.
C. Clean glass and adjacent surfaces after sealants are fully cured.
D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.09 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION 08.80.00
PART 1  GENERAL -- NOT USED

1.01  SECTION INCLUDES
   A. Glass mirrors.
      1. Annealed float glass.

1.02  REFERENCE STANDARDS
   D. GANA (GM) - GANA Glazing Manual; 2009.
   F. GANA (TIPS) - Mirrors: Handle with Extreme Care (Tips for the Professional on the Care and Handling of Mirrors); 2011.

1.03  SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
   C. Product Data on Glazing Compounds: Submit chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
   D. Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.
   E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
   F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.04  QUALITY ASSURANCE
   A. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods.
   B. Fabricate, store, transport, receive, install, and clean mirrors in accordance with recommendations of GANA (TIPS).

1.05  FIELD CONDITIONS
   A. Do not install mirrors when ambient temperature is less than 50 degrees F.
   B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.06  WARRANTY
   A. See Section 01.78.00 - Closeout Submittals, for additional warranty requirements.
   B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.
PART 2  PRODUCTS

2.01  MATERIALS
A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.
B. Mirror Glass: ASTM C1036, Type 1 - Transparent Flat, Class 1 - Clear, Quality - Q1 (high-quality mirrors); silvering, protective coating, and quality requirements in compliance with ASTM C1503. Provide with polished edges.
   1. Thickness: 1/4 inch
   2. Size: As noted on drawings.

2.02  ACCESSORIES
A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness.
B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness.
C. Glazing Tape: Preformed butyl compound; 10 to 15 Shore A durometer hardness; on release paper.
D. Glazing Clips: Manufacturer's standard type.
E. Mirror Attachment Accessories: Stainless steel clips.
F. Mirror Adhesive: Chemically compatible with mirror coating and wall substrate.
G. Channel Frame: One piece, channel frame, stainless steel, Type 430, polished finish, 1/2 inch by 1/2 inch by 3/8 inch deep with 90 degree mitered corners.

PART 3  EXECUTION -- NOT USED

3.01  EXAMINATION
A. Verify that openings for mirrored glazing are correctly sized and within tolerance.
B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02  PREPARATION
A. Clean contact surfaces with solvent and wipe dry.
B. Seal porous mirror frames or recesses with substrate compatible primer or sealer. Prime surfaces scheduled to receive sealant.
C. Prepare installation in accordance with ASTM C1193 for solvent release sealants, and install sealant in accordance with manufacturer's instructions.

3.03  INSTALLATION
A. Install mirrors in accordance with GANA (TIPS) and manufacturers recommendations.
B. Set mirrors plumb and level, and free of optical distortion.
C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.
D. Installation in Frames:
   1. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.
   2. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
   3. Rest mirrors on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
   4. Place glazing tape on free perimeter of mirrors in same manner described above.
5. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
6. Trim protruding tape edge.

E. Frameless Mirrors: Set mirrors in proper place with adhesive, applied in accordance with adhesive manufacturer's instructions.

3.04 CLEANING

A. Remove wet glazing materials from finish surfaces.
B. Remove labels after work is complete.
C. Clean mirrors and adjacent surfaces.

END OF SECTION 08.83.00
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Louvers, frames, and accessories.

1.02 RELATED REQUIREMENTS
A. Section 07.62.00 - Sheet Metal Flashing and Trim.
B. Section 07.92.00 - Joint Sealants: Sealing joints between frames and adjacent construction.

1.03 REFERENCE STANDARDS
B. AMCA 511 - Certified Ratings Program for Air Control Devices; 2010.

1.04 SUBMITTALS
A. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
B. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames.
C. Test Reports: Independent agency reports showing compliance with specified performance criteria.
D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
E. Maintenance Data: Include lubrication schedules, adjustment requirements.

1.05 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 WARRANTY
A. Provide twenty year manufacturer warranty against distortion, metal degradation, and failure of connections.
   1. Finish: Include coverage against degradation of exterior finish.

PART 2 PRODUCTS

2.01 LOUVERS
A. Louvers: Factory fabricated and assembled, complete with frame, Mullions, and accessories; AMCA Certified in accordance with AMCA 511.
   1. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame. Provide storm resistant configuration of blades.
   2. Screens: Provide insect screens at intake louvers and bird screens at exhaust louvers.
B. Stationary Louvers: Horizontal blade, extruded aluminum construction, with intermediate Mullions matching frame.
   1. Free Area: 50 percent, minimum.
3. Frame: Depth as indicated on drawings, channel profile; corner joints mitered and, with continuous recessed caulking channel each side.
4. Aluminum Thickness: Frame 12 gage, 0.0808 inch minimum; blades 12 gage, 0.0808 inch minimum.
5. Aluminum Finish: Pigmented organic polyester or acrylic coatings; finish welded units after fabrication.

C. Operable Louvers: Operable horizontal blades, extruded aluminum construction.
   1. Free Area: 50 percent, minimum.
   2. Operation: Gravity balanced, 90 degree opening. with adjustment device to permit setting for varying differential static pressure.
   3. Movable Blades: Drainable, pivoted at, with vinyl, rubber, or polyethylene blade edge and jamb seals; rattle-free linkage.
   5. Frame: Depth as indicated on drawings, channel profile; corner joints mitered and, with continuous recessed caulking channel each side.
   6. Aluminum Thickness: Frame 12 gage, 0.0808 inch minimum; blades 12 gage, 0.0808 inch minimum.
   7. Aluminum Finish: Pigmented organic polyester or acrylic coatings; finish welded units after fabrication.

2.02 MATERIALS

2.03 FINISHES
   A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

2.04 ACCESSORIES
   A. Blank-Off Panels: Aluminum face and back sheets, polyisocyanurate foam core, 1-1/2 inch thick, painted black on exterior side; provide where duct connected to louver is smaller than louver frame, sealing off louver area outside duct.
   B. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame.
   C. Bird Screen: Interwoven wire mesh of steel, 14 gage, 0.0641 inch diameter wire, 1/2 inch open weave, diagonal design.
   D. Insect Screen: 18 x 16 size aluminum mesh.
   E. Fasteners and Anchors: Stainless steel.
   F. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.
   G. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.
   B. Verify that field measurements are as indicated.
3.02 INSTALLATION
   A. Install louver assembly in accordance with manufacturer's instructions.
   B. Install louvers level and plumb.
   C. Set sill members and sill flashing in continuous bead of sealant.
   D. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
   E. Secure louver frames in openings with concealed fasteners.
   F. Coordinate with installation of mechanical ductwork.
   G. Coordinate with installation of louver actuators.

3.03 ADJUSTING
   A. Adjust operable louvers for freedom of movement of control mechanism. Lubricate operating joints.

3.04 CLEANING
   A. Strip protective finish coverings.
   B. Clean surfaces and components.

END OF SECTION 08.91.00
SECTION 09.21.16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Performance criteria for gypsum board assemblies.
   B. Metal stud wall framing.
   C. Metal channel ceiling framing.
   D. Acoustic insulation.
   E. Cementitious backing board.
   F. Gypsum wallboard.
   G. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS
   A. Section 05.40.00 - Cold-Formed Metal Framing: Exterior wind-load-bearing metal stud framing.
   B. Section 06.10.00 - Rough Carpentry: Wood blocking product and execution requirements.
   C. Section 09.22.16 - Non-Structural Metal Framing.

1.03 REFERENCE STANDARDS
   A. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units; 2010 (Revised).
   I. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
   J. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.


Q. ASTM E413 - Classification for Rating Sound Insulation; 2010.


S. GA-226 - Application of Gypsum Board to Form Curved Surfaces; Gypsum Association; 2008.


1.04 SUBMITTALS

A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.

C. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

E. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum three years of experience.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 55-59 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
   1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
   2. Acoustic Attenuation: STC of 50-54 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

D. Shaft Walls at Elevator Shafts: Provide completed assemblies with the following characteristics:
   1. Air Pressure Within Shaft: Intermittent loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
   2. Acoustic Attenuation: STC of 50-54 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

E. Fire Rated Assemblies: Provide completed assemblies complying with applicable code.
   1. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.
   2. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.
3. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS
A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
   1. Studs: "C" shaped with flat or formed webs with knurled faces.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: C-shaped.
B. Exterior Non-Loadbearing Studs and Furring for Application of Gypsum Board: As specified in Section 09.22.16.
C. Loadbearing Studs for Application of Gypsum Board: As specified in Section 05.40.00.
D. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
E. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
F. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and screwed to secondary deflection channel set inside but unattached to top track.

2.03 BOARD MATERIALS
A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Unfaced fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
   3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   4. Thickness:
B. Abuse Resistant Wallboard:
   1. Application: High-traffic areas indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Type: Fire resistance rated Type X, UL or WH listed.
   5. Edges: Tapered.
C. Impact Resistant Wallboard:
   1. Application: High-traffic areas indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Type: Fire resistance rated Type X, UL or WH listed.
   5. Edges: Tapered.
D. Backing Board For Wet Areas: One of the following products:
   1. Application: Surfaces behind tile in wet areas including tub and shower surrounds and shower ceilings.
   2. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
a. Thickness: 1/2 inch.

E. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
   1. Application: Vertical surfaces behind thinset tile, except in wet areas.
   2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.

F. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut. For all areas greater than 120 square feet and are not accessible, provide a 24” x 24” accessible panel. Coordinate location with Mechanical.
   1. Application: Ceilings, unless otherwise indicated.
   2. Thickness: 1/2 inch.

G. Acoustical Fiberboard: ASTM C208 cellulosic fiberboard without facing or coating; square edged.
   1. Thickness: 1/2 inch.
   2. In 1-Hour Fire-Rated Partitions: UL listed for assembly used.

H. Exterior Soffit Board: Exterior gypsum soffit board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Ceilings and soffits in protected exterior areas, unless otherwise indicated.
   2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X.

2.04 ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: ______ inch.

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

C. Beads, Joint Accessories, and Other Trim: ASTM C1047, paintable galvanized steel or rolled zinc, unless noted otherwise.
   1. Rigid Corner Beads: Low profile, for 90 degree outside corners and archways.
   2. Architectural Reveal Beads:
      b. Reveal Width: 5/8 inch.
      c. Shapes: As shown on drawings.

D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.

E. High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.

F. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

G. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.

H. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION
A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
   1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches on center.
   2. Install studs at spacing required to meet performance requirements.
B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
   1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
   2. Seal perimeter of shaft wall and penetrations with acoustical sealant.

3.03 FRAMING INSTALLATION
A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
C. Studs: Space studs at 16 inches on center.
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
   3. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.
D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
   1. Orientation: Horizontal.
   2. Spacing: As indicated.
F. Acoustic Furring: Install resilient channels at maximum 16 inches on center. Locate joints over framing members.
G. Furring for Fire Ratings: Install as required for fire resistance ratings indicated.
H. Blocking: Install wood blocking for support of:
   1. Framed openings.
   2. Wall mounted cabinets.
   3. Plumbing fixtures.
   4. Toilet partitions.
   5. Toilet accessories.
   6. Wall mounted door hardware.

3.04 ACOUSTIC ACCESSORIES INSTALLATION
A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Place one bead continuously on substrate before installation of perimeter framing members.
   2. Place continuous bead at perimeter of each layer of gypsum board.
3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.05 BOARD INSTALLATION
A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
D. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
E. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.
F. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
G. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
H. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.
I. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

3.06 INSTALLATION OF TRIM AND ACCESSORIES
A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
   2. At exterior soffits, not more than 30 feet apart in both directions.
B. Corner Beads: Install at external corners, using longest practical lengths.
C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.
D. Exterior Soffit Vents: Install according to manufacturer's written instructions and in locations shown on the drawings. Provide vent area specified.

3.07 JOINT TREATMENT
A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
   2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   4. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.
C. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
D. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.
3.08 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 09.21.16
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Metal partition, ceiling, and soffit framing.
   B. Framing accessories.

1.02 RELATED REQUIREMENTS
   A. Section 05.21.00 - Steel Joists: Execution requirements for anchors for attaching work of this section.
   B. Section 05.40.00 - Cold-Formed Metal Framing: Structural load bearing metal stud framing and Exterior wall stud framing.
   C. Section 05.40.00 - Cold-Formed Metal Framing: Execution requirements for anchors for attaching work of this section.
   D. Section 05.50.00 - Metal Fabrications: Metal fabrications attached to stud framing.
   E. Section 05.50.00 - Metal Fabrications: Execution requirements for anchors for attaching work of this section.
   F. Section 06.10.00 - Rough Carpentry: Wood blocking within stud framing.
   G. Section 06.10.00 - Rough Carpentry: Wall sheathing.
   H. Section 07.21.00 - Thermal Insulation: Acoustic insulation.
   I. Section 08.31.00 - Access Doors and Panels.
   J. Section 09.21.16 - Gypsum Board Assemblies: Metal studs for gypsum board partition framing.
   K. Section 09.21.16 - Gypsum Board Assemblies: Execution requirements for anchors for attaching work of this section.

1.03 REFERENCE STANDARDS
   A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
   B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
   F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
   H. ASTM E413 - Classification for Rating Sound Insulation; 2010.

1.04 SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Shop Drawings:
1. Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.

2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.

C. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.

D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

F. Sustainable Design Submittal: Documentation of recycled content and location of manufacture.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

1.06 MOCK-UP

A. Provide mock-up of stud wall, ceiling, and soffit framing including insulation, sheathing, window frame, and door frame and finish specified in other sections. Coordinate with installation of associated work specified in other sections.

1. Mock-up Size: Full height, minimum 12 feet long, including corner.

PART 2 PRODUCTS

2.01 FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.

1. Studs: C shaped with flat or formed webs with knurled faces.

2. Runners: U shaped, sized to match studs.

B. Loadbearing Studs: As specified in Section 05.40.00.

C. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.

1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.


3. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet.

E. Tracks and Runners: Same material and thickness as studs, bent leg retainer notched to receive studs with provision for crimp locking to stud.

F. Furring and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C754.


H. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced.
I. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

2.02 FABRICATION
A. Fabricate assemblies of framed sections to sizes and profiles required.
B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify existing conditions before starting work.
B. Verify that rough-in utilities are in proper location.

3.02 INSTALLATION OF STUD FRAMING
A. Comply with requirements of ASTM C754.
B. Extend partition framing to structure where indicated and to ceiling in other locations.
C. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
D. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
E. Align and secure top and bottom runners at 24 inches on center.
F. At partitions indicated with an acoustic rating:
   1. Provide components and install as required to produce STC ratings as indicated, based on published tests by manufacturer conducted in accordance with ASTM E90 with STC rating calculated in accordance with ASTM E413.
   2. Place one bead of acoustic sealant between runners and substrate, studs and adjacent construction.
   3. Place one bead of acoustic sealant between studs and adjacent vertical surfaces.
G. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
H. Install studs vertically at spacing indicated on drawings.
I. Align stud web openings horizontally.
J. Secure studs to tracks using crimping method. Do not weld.
K. Stud splicing is not permissible.
L. Fabricate corners using a minimum of three studs.
M. Double stud at wall openings, door and window jambs, not more than 2 inches from each side of openings.
N. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.
O. Blocking: Use wood blocking secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and opening frames.

3.03 CEILING AND SOFFIT FRAMING
A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
B. Install furring independent of walls, columns, and above-ceiling work.
C. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.

D. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.

E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

F. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.

G. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.

H. Laterally brace suspension system.

**3.04 TOLERANCES**

A. Maximum Variation From True Position: 1/8 inch in 10 feet.

B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

END OF SECTION 09.22.16
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Metal lath for cement and gypsum plaster.

1.02 RELATED REQUIREMENTS
   A. Section 05.40.00 - Cold-Formed Metal Framing: Water-resistive barrier under exterior plaster and stucco.
   B. Section 07.25.00 - Weather Barriers: Weather barrier under exterior plaster and stucco.
   C. Section 08.31.00 - Access Doors and Panels: Product requirements for metal access panels integral with metal lath.
   D. Section 09.22.16 - Non-Structural Metal Framing.
   E. Section 09.23.00 - Gypsum Plastering.

1.03 REFERENCE STANDARDS
   C. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
   D. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.

1.04 SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on furring and lathing components, structural characteristics, material limitations, and finish.

1.05 QUALITY ASSURANCE
   A. Maintain one copy of each installation standard referenced on site throughout the duration of lathing and plastering work.
   B. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

PART 2 PRODUCTS

2.01 FRAMING AND LATH ASSEMBLIES
   A. Provide completed assemblies with the following characteristics:
      1. Maximum Deflection of Vertical Assemblies: 1:360 under lateral point load of 100 lbs.
   B. Fire Rated Assemblies: Provide components complying with requirements for fire rated assemblies specified in the section where the plaster finish is specified.
2.02 LATH

   1. Weight: To suit application and as specified in ASTM C841 or ASTM C1063 for framing spacing.
B. Corner Mesh: Formed sheet steel, minimum 0.018 inch thick, perforated flanges shaped to permit complete embedding in plaster, minimum 2 inch size; same finish as lath.
C. Beads, Screeds, Joint Accessories, and Other Trim: Depth governed by plaster thickness, and maximum possible lengths.
   1. Material: Formed sheet steel with rust inhibitive primer, expanded metal flanges.
   5. Control Joints: Accordion profile with protective tape, 2 inch flanges.

2.03 ACCESSORIES

A. Access Panels: As specified in Section 08.31.00.
B. Anchorage: Tie wire, nails, and other metal supports, of type and size to suit application; to rigidly secure materials in place, galvanized.
C. Fasteners: Self-piercing tapping screws; ASTM C1002 or ASTM C954.
D. Tie Wire: Annealed galvanized steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that substrates are ready to receive work and conditions are suitable for application.
C. For exterior plaster and stucco on stud walls, verify that weather barrier has been installed over sheathing substrate completely and correctly.
D. Do not begin until unacceptable conditions have been corrected.
E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION - GENERAL

A. Install interior lath and furring for gypsum plaster in accordance with ASTM C841.
B. Install metal lath and furring for Portland cement plaster in accordance with ASTM C1063.
C. Install lath and furring for fire-rated assemblies in accordance with requirements of assembly as indicated.

3.03 CONTROL AND EXPANSION JOINT INSTALLATION

A. Locate joints as indicated on drawings and comply with ASTM C1063.
   1. Area of plaster panel not to exceed 144 sq ft for vertical surfaces.
   2. Spacing between control joints not to exceed 18 ft in each direction.
   3. Area bounded by control joints not to exceed a length-to-width ratio of 2-1/2 to 1.
B. Install expansion joints where an expansion joint occurs in base exterior wall.
C. Install prefabricated joint accessories in accordance with ASTM C1063.
D. Construct expansion joints of back-to-back casing beads with a backer rod and sealant, set 1/4 inch apart.
3.04 ACCESS PANELS INSTALLATION
   A. Install access panels and rigidly secure in place.
   B. Install frames plumb and level in opening. Secure rigidly in place.
   C. Position to provide convenient access to concealed work requiring access.

3.05 LATH INSTALLATION
   A. Apply lath taut, with long dimension perpendicular to supports.
   B. Lap or nest ends of metal lath in accordance with ASTM C841.
   C. Secure end laps with tie wire where they occur between supports.
   D. Attach metal lath to concrete and concrete masonry using wire loops. Attach anchors to backup surface; space at maximum 24 inches on center.
   E. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches from corner to form the angle reinforcement; fasten at perimeter edges only.
   F. Place corner bead at external wall corners; fasten at outer edges of lath only.
   G. Place base screeds at termination of plaster areas; secure rigidly in place.
   H. Place 4 inch wide strips of lath centered over junctions of dissimilar backing materials, and secure rigidly in place.
   I. Place lath vertically above each top corner and each side of door frames to 6 inches above ceiling line.
   J. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.
   K. Place additional strip mesh diagonally at corners of lathed openings. Secure rigidly in place.

3.06 TOLERANCES
   A. Maximum Variation from True Lines and Levels: 1/8 inch in 10 feet.
   B. Maximum Variation from True Position: 1/8 inch.

END OF SECTION 09.22.36
SECTION 09.23.00
GYPSUM PLASTERING

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Gypsum plastering.
   B. Gypsum plaster over gypsum lath, metal lath, and concrete.
   C. Gypsum lath.

1.02 RELATED REQUIREMENTS
   A. Section 05.40.00 - Cold-Formed Metal Framing: Metal stud framing for plaster.
   B. Section 06.10.00 - Rough Carpentry: Wood stud framing for plaster.
   C. Section 07.84.00 - Firestopping: Sealing top-of-wall assemblies and through-wall penetrations at fire rated walls.
   D. Section 07.92.00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
   E. Section 08.31.00 - Access Doors and Panels: Access panels.
   F. Section 09.21.16 - Gypsum Board Assemblies: Metal stud framing and furring for plaster.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. Product Data: Provide data on plaster materials, characteristics, and limitations of products specified.

1.05 QUALITY ASSURANCE
   A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

1.06 MOCK-UP
   A. Construct mock-up of interior wall, 6 feet long by 10 feet wide, illustrating surface finish.
   B. Locate where directed.
   C. Mock-up may remain as part of the Work.

1.07 FIELD CONDITIONS
   A. Do not apply plaster when substrate or ambient air temperature is under 50 degrees F or over 80 degrees F.
   B. Maintain minimum ambient temperature of 50 degrees F during and after installation of plaster.

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ISSUED: 3/13/2017
PART 2 PRODUCTS

2.01 PLASTER MATERIALS
B. Ready-Mixed Gypsum Plaster: ASTM C28/C28M; mill-mixed type, requiring only the addition of water.
C. Lime: ASTM C206, Type S; special finishing hydrated lime.

2.02 LATH AND ACCESSORIES
A. Gypsum Lath: ASTM C1396/C1396M, standard type.
B. Beads, Screeds, Joint Accessories, and Other Trim: Depth governed by plaster thickness, maximum possible lengths.
   1. Material: Formed sheet steel with rust inhibitive primer, expanded metal flanges.
C. Corner Mesh: Formed sheet steel, minimum 0.018 inch thick, perforated flanges shaped to permit complete embedding in plaster, minimum 2 inch size; galvanized.
D. Strip Mesh: Expanded metal lath, minimum 0.018 inch thick, 2 inch wide by 24 inch long; galvanized.
E. Fasteners: Nails, staples, or other approved metal supports, of type and size to suit application, to rigidly secure accessories in place.

2.03 PLASTER MIXES
A. Over Other Solid Bases: Two-coat application, ready-mixed plaster, mixed and proportioned in accordance with ASTM C842 and manufacturer's instructions. Total application thickness 5/8 inch.
B. Over Metal Lath: Three-coat application, ready-mixed plaster, mixed and proportioned in accordance with ASTM C842 and manufacturer's instructions.
C. Ready-Mixed Plaster Materials: Mix in accordance with manufacturer's instructions.
D. Finish Coat for Troweled Finish: Lime putty with gypsum gauging plaster, mixed and proportioned in accordance with ASTM C842.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that existing conditions are satisfactory before starting work.
B. Masonry: Verify joints are cut flush and surface is ready to receive work of this section. Verify no bituminous or water repellent coatings exist on masonry surface.
C. Concrete: Verify surfaces are flat, honeycomb is filled flush, and surface is ready to receive work of this section. Verify no bituminous, water repellent, or form release agents exist on concrete surface that are detrimental to plaster or plaster bond.
D. Grounds and Blocking: Verify items within walls for other sections of work have been installed.
E. Gypsum Lath and Accessories: Verify substrate is flat and surface is ready to receive work of this section. Verify joint and surface perimeter accessories are in place.
F. Metal Lath and Accessories: Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are in place.
G. Mechanical and Electrical: Verify services within walls have been tested and approved.

3.02 PREPARATION
A. Dampen masonry surfaces to reduce excessive suction.

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ISSUED: 3/13/2017
B. Clean concrete surfaces of foreign matter. Thoroughly dampen surfaces before using acid solutions, solvent, or detergents to perform cleaning. Wash surface with clean water.

C. Roughen smooth concrete surfaces and smooth faced masonry.

D. Apply bonding agent in accordance with manufacturer's instructions.

3.03 PLASTERING
A. Apply gypsum plaster in accordance with ASTM C842 and manufacturer's instructions.

B. Thickness of Plaster including Finish Coat:
   2. Direct to unit masonry: 5/8 inch.
   3. Finish coat applied direct to concrete: 3/16 inch, maximum.
   5. To horizontal concrete surfaces: 1/8 to 3/8 inch.

C. Finish Texture: Float to a consistent and smooth finish.

D. Perform work in panels to nearest natural break or between accessories.

3.04 TOLERANCES
A. Maximum Variation from True Flatness: 1/8 inch in 10 feet.

END OF SECTION 09.23.00
PART 1 GENERAL -- NOT USED

1.01 SECTION INCLUDES
   A. Glass-fiber-reinforced gypsum fabrications as indicated on drawings.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. Product Data: Manufacturer's data sheets on each product to be used, including dimensions, finishes, storage and handling requirements and recommendations, and installation recommendations.
   B. Shop Drawings: For custom items, provide drawings showing dimensions, layout, joints, details, fastening, and interface with adjacent work; include field measured dimensions of the spaces where items are to be installed, if critical to proper installation.
   C. Samples: For each custom finish specified, two samples, minimum size 6 inches square, representing actual product, color, and patterns.

1.05 DELIVERY, STORAGE, AND HANDLING
   A. Transport, lift, and handle units with care, avoiding excessive stress and preventing damage; use appropriate equipment.
   B. Store products in manufacturer's unopened packaging until ready for installation, in a clean dry area protected from weather, moisture and damage; store units upright and not stacked unless permitted by manufacturer.

PART 2 PRODUCTS

2.01 GYPSUM FABRICATIONS (INTERIOR USE ONLY)
   A. Glass-Fiber-Reinforced Gypsum Fabrications: Molded glass fiber reinforced gypsum with structural reinforcing as required.
      1. Surface Burning Characteristics: Flame spread index of 0 (zero), smoke developed index of 10, maximum, when tested in accordance with ASTM E84.
      2. Surface Finish: Suitable for flat paint finish, without pinholes, voids, or roughness.
      3. Material Characteristics: Complying with ASTM C1355/C1355M.
      4. Items Too Large or Heavy to be Adhesively Installed: Provide concealed anchorage points for plaster type wire anchors.
      5. Glass Content: Minimum 5 percent by weight.
      7. Shell Thickness: 3/16 inch, minimum.
     10. Draft Angle: 3 degrees, minimum, on returns, setbacks, reveals, and grooves.
     11. Dimensional Tolerances of Molded Surfaces:
a. Straightness: Maximum of 1/8 inch in 8 linear feet variation from straight at any point along any plane, edge, or surface.
c. Dimensions Within Overall Width and Length: Plus/minus 1/16 inch.

B. Joint Cement: Type recommended by fabrication manufacturer.
C. Joint Tape and Compound: Types recommended for gypsum wallboard work.

PART 3 EXECUTION

3.01 EXAMINATION
A. Do not begin installation until substrates have been properly constructed; verify that substrates are plumb and true.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
C. Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Architect and wait for instructions before beginning installation.

3.02 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. Install supplementary temporary and permanent supports as required for proper installation.

3.03 INSTALLATION
A. Install in accordance with applicable code and manufacturer's recommendations, plumb and true to line; shim where necessary.
B. Coordinate work with installation of substrates.
C. Join pieces with cemented butt joints except at control and expansion joints.
D. Provide control joints at not more than 35 feet on center if not indicated on drawings.
E. Provide expansion joints where moving joints in substrate occur.
F. Finish joints and surfaces as required for Level 5 in ASTM C840.

3.04 PROTECTION
A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 09.27.00
SECTION 09.30.00
TILING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Tile for floor applications.
B. Tile for wall applications.
C. Cementitious backer board as tile substrate.
D. Stone thresholds.
E. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS
E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2009 (Revised).
O. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2012 (Revised).

1.04 ADMINISTRATIVE REQUIREMENTS
A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS
A. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
B. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
C. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.
D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
E. Master Grade Certificate: Submit for each type of tile, signed by the tile manufacturer and tile installer.
F. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Tile: 10 square feet of each size, color, and surface finish combination.

1.06 QUALITY ASSURANCE
A. Maintain one copy of and ANSI A108/A118/A136.1 and TCNA (HB) on site.
B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
C. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.

1.07 MOCK-UP
A. Construct tile mock-up where indicated on the drawings, incorporating all components specified for the location.
   1. Minimum size of mock-up is indicated on the drawings.
   2. Approved mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING
A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.
1.09 FIELD CONDITIONS
   A. Do not install solvent-based products in an unventilated environment.
   B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

PART 2 PRODUCTS

2.01 TILE
   A. Manufacturers: All products by the same manufacturer.
   B. Porcelain Tile: ANSI A137.1, standard grade.
      1. Size: as scheduled in Finish Legend.
      2. Thickness: 3/8 inch.
      3. Edges: Cushioned.
      4. Color(s): As scheduled.

2.02 TRIM AND ACCESSORIES
   A. Non-Ceramic Trim: Brushed stainless steel, style and dimensions to suit application, for setting using tile mortar or adhesive.
      1. Applications:
         a. Open edges of wall tile.
         b. Open edges of floor tile.
         c. Wall corners, outside and inside.
         d. Transition between floor finishes of different heights.
         e. Expansion and control joints, floor and wall.
         f. Floor to wall joints.
         g. Balcony and terrace edge trim and fascia.
   B. Thresholds: Marble, white or gray, honed finish; 2 inches wide by full width of wall or frame opening; 1/2 inch thick; beveled one long edge with radius corners on top side; without holes, cracks, or open seams.

2.03 SETTING MATERIALS
   A. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4 or ANSI A118.15.
   B. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.
   C. Adhesive for Bonding Fleece-Backed Underlayments to Non-Cementitious Substrates: Water-based rubber resin.

2.04 GROUTS
   A. Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
      1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
      2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
   B. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
      1. Applications: Toilet spaces.
      2. Color(s): As selected by Architect from manufacturer's full line.
   C. Stain Resistant Grout Additive: Liquid admixture for sanded and unsanded cement-based grouts; mix with dry grout material in place of water.
      1. Applications: Where indicated.
2.05 MAINTENANCE MATERIALS
A. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
1. Composition: Water-based colorless silicone.

2.06 ACCESSORY MATERIALS
A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
1. Type: Trowel-applied.
2. Thickness: 20 mils, maximum.
3. Crack Resistance: No failure at 1/16 inch gap, minimum.
B. Waterproofing Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
C. Underlayment at Floors: Specifically designed for bonding to thin-set setting mortar; not primarily a waterproofing material and having the following characteristics:
1. Crack Resistance: No failure at 1/16 inch gap, minimum; comply with ANSI A118.12.
3. Uncoupling Function: Allow for separation between membrane and the mortar adhering tile to the membrane when subjected to excessive substrate movement.
D. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 1/2 inch thick; 2 inch wide coated glass fiber tape for joints and corners.
E. Backer Board: High density polystyrene with reinforced cementitious coating on both sides; with compatible alkaline resistant joint tape; to be covered with waterproofing prior to installation of tile.
1. Thickness: 1/2 inch.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.
E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION
A. Protect surrounding work from damage.
B. Vacuum clean surfaces and damp clean.
C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.
3.03 INSTALLATION - GENERAL

A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

E. Form internal angles square and external angles bullnosed.

F. Install non-ceramic trim in accordance with manufacturer's instructions.

G. Install thresholds where indicated.

H. Sound tile after setting. Replace hollow sounding units.

I. Keep control and expansion joints free of mortar, grout, and adhesive.

J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

K. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.

L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.

1. Use uncoupling membrane under all tile unless other underlayment is indicated.

2. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.

3. Where epoxy bond coat and grout are indicated, install in accordance with TCNA (HB) Method F131.

B. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.05 INSTALLATION - WALL TILE

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.

B. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.

C. Over metal studs without backer install in accordance with TCNA (HB) Method W241, mortar bed, with membrane where indicated.

3.06 CLEANING

A. Clean tile and grout surfaces.

3.07 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION 09.30.00
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Suspended metal grid ceiling system.
   B. Acoustical units.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS
   D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

1.04 ADMINISTRATIVE REQUIREMENTS
   A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
   B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Shop Drawings: Indicate grid layout and related dimensioning.
   C. Product Data: Provide data on suspension system components.
   D. Manufacturer's Installation Instructions: Indicate special procedures.

1.06 QUALITY ASSURANCE
   A. Fire-Resistive Assemblies: Complete assembly listed and classified by UL (FRD) for the fire resistance indicated.
   B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
   C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 FIELD CONDITIONS
   A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.
PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.
   1. Units for Installation in Fire-Rated Suspension System: Listed and classified for the fire-resistive assembly as part of suspension system.

B. Acoustical Panels: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:
   1. Size: 24 by 24 inches.
   2. Thickness: 5/8 inches.
   3. Composition: Wet felted.
   4. Light Reflectance: 83 percent, determined in accordance with ASTM E1264.
   5. NRC: 0.50
   7. Edge: Beveled Tegular.
   8. Surface Color: To be selected by Architect from manufacturer's standard line.
   9. Surface Pattern: See Finish Legend for specific pattern(s).
   10. Suspension System: 9/16" Exposed grid unless noted otherwise.
   11. Products:

C. Glass Fiber Acoustical Panels: Vinyl faced glass fiber, ASTM E1264 Type XII, with the following characteristics:
   1. Size: 24 by 24 inches.

2.02 SUSPENSION SYSTEM(S)

A. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.

B. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.
   1. Profile: Tee; 15/16 inch wide face.
   2. Construction: Double web.
   4. Products:

C. Fire-Rated Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; light-duty.
   1. Profile: Tee; 9/16 inch wide face.
   2. Construction: Double web.

2.03 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Perimeter Moldings: Same material and finish as grid.
   1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.

C. Gypsum Board: Fire rated type; 5/8 inch thick, ends and edges square, paper faced.

D. Gasket For Perimeter Moldings: Closed cell rubber sponge tape.

E. Touch-up Paint: Type and color to match acoustical and grid units.
PART 3 EXECUTION

3.01 EXAMINATION
A. Verify existing conditions before starting work.
B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM
A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
C. Locate system on room axis according to reflected plan.
D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
E. Hang hanger clips during steel deck erection. Provide additional hangers and inserts as required.
F. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
G. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
I. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
J. Do not eccentrically load system or induce rotation of runners.
K. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Install with continuous gasket.
   2. Use longest practical lengths.
   3. Overlap and rivet corners.
L. Install light fixture boxes constructed of gypsum board above light fixtures in accordance with fire rated assembly requirements and light fixture ventilation requirements.

3.03 INSTALLATION - ACOUSTICAL UNITS
A. Install acoustical units in accordance with manufacturer's instructions.
B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
C. Fit border trim neatly against abutting surfaces.
D. Install units after above-ceiling work is complete.
E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
F. Cutting Acoustical Units:
   1. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.
   3. Double cut and field paint exposed reveal edges.
G. Where round obstructions occur, provide preformed closures to match perimeter molding.
H. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.
3.04 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION 09.51.00
PART 1  GENERAL

1.01  SECTION INCLUDES
   A. Wood strip and plank flooring, nailed.
   B. Sheet vapor retarder.

1.02  RELATED REQUIREMENTS
   A. Section 09.91.23 - Interior Painting: Surface finish to flooring.

1.03  REFERENCE STANDARDS

1.04  SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data for flooring.
   C. Shop Drawings: Indicate floor joint pattern and termination details.
      1. Indicate provisions for expansion and contraction.
   D. Installation Instructions: Indicate standard and special installation procedures.
   E. Maintenance Data: Include maintenance procedures and recommended maintenance materials.
   F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
      1. Extra Flooring Material: 10 square yards matching installed flooring.

1.05  QUALITY ASSURANCE
   A. Perform work of this section in accordance with MFMA (SPEC) and NWFA (IG).
   B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
   C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06  FIELD CONDITIONS
   A. Do not install wood flooring until wet construction work is complete and ambient air at installation space has moisture content stabilized at maximum moisture content of 40 percent.
   B. Provide heat, light, and ventilation prior to installation.
   C. Store materials in area of installation for minimum period of 24 hours prior to installation.
   D. Maintain minimum room temperature of 65 degrees F for a period of two days prior to delivery of materials to installation space, during installation, and after installation.

PART 2  PRODUCTS

2.01  MATERIALS
   A. Wood Strip Flooring:
      1. Species: White Oak.
      2. Grade: First.
3. Cut: Flat grain.
5. Actual Width: 2-1/4 inches.
7. End: End matched.
8. Length: Random, minimum of 9 inches.

B. Flooring Nails: Type recommended by flooring manufacturer.

C. Sleepers and Shims: Softwood lumber, pressure treated for moisture protection, No. 2 grade or better 2 by 4 inch size sitting on 3/4” Mason Super W resilient pads. Sleepers shall be spaced at 16” on center.

D. Secondary Subflooring: 2 layers of 5/8” grade "C" or better plywood with 1 layer of either 1/4” stageboard or 1 layer 1/4” painted tempered hardboard to match Robbins Bio-Channel Classic Sleeper system. Lap layers of secondary plywood to avoid aligned joints.

E. Fill spaces between sleepers with SAFB Mineral wool batt sound insulation.

F. Vapor Retarder: Black polyethylene sheet, 8 mil thick; 2 inch wide tape for joint sealing.

G. Provide expansion joint cover at transitions to other materials.

2.02 ACCESSORIES

A. Cushion Blocks: Resilient pads, rubber material, sealed air channels for resiliency; compressible to 1/16 inch under a 40 psi load with full and immediate recovery.

B. Perimeter Springs: Flat spring steel, leaf shaped, with attachment clips, 0.093 by 1 by 9 inch size.

C. Transition Strip: Same species and finish as flooring material; profiles indicated.

D. Floor Finish: Specified in Section 09.91.23.

E. Sealer and Wax: Types recommended by flooring manufacturer.

2.03 SOURCE QUALITY CONTROL

A. Inspect and stamp species and grade on underside of each piece of wood flooring at factory.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting this work.

B. Verify that concrete subfloor surface is smooth and flat to plus or minus 1/4 inch in 10 feet.

C. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Sleepers and Shims:
   1. Place vapor retarder over subfloor surface, lapping edges and ends minimum 6 inches and tape seal; staple in place.
   2. Place sleepers over vapor retarder; space sleepers at 12 inches on center.
   3. Shim underside of sleepers to achieve level line of plus or minus 1/4 inch in 10 feet.
   4. Anchor sleepers to concrete substrate with explosive driven concrete nails; place nails at 16 inches on center.

B. Cushioned Sleepers:
   1. Secure cushion blocks to underside of sleepers at 12 inches oc and at each end. Shim between blocks and sleepers for equal bearing on floor surface and to achieve level line of plus or minus 1/4 inch in 10 feet.
   2. Place sleepers over subfloor; space sleepers at 12 inches on center; do not secure to subfloor.
C. Secondary Subflooring: Place two layers of plywood subflooring over sleepers.
   1. Lay the first layer perpendicular to the sleepers, with end joints over sleepers, and nail at 12 inches on center.
D. Prepare substrate to receive wood flooring in accordance with manufacturer's, MFMA, and NWFA instructions.
E. Broom clean substrate.

3.03 INSTALLATION
A. Sheathing Paper: Place over wood subfloor; lap edges and ends 2 inches, staple in place.
B. Wood Flooring:
   1. Install in accordance with manufacturer's, MFMA, and NWFA instructions; predrill and blind nail to sleepers.
   2. Lay flooring parallel to length of room areas. Verify alignment as work progresses.
   3. Arrange flooring with end matched grain set flush and tight.
   4. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar; provide divider strips and transition strips in accordance with flooring manufacturer's recommendations and as indicated.
   5. Install edge strips at unprotected or exposed edges, and where flooring terminates.
   7. Install flooring tight to floor access covers.
   8. Provide ___ inch expansion space at fixed walls and other interruptions.
C. Install base at floor perimeter to cover expansion space in accordance with manufacturer's instructions. Miter inside and outside corners.
D. Install floor sockets and inserts to a depth sufficient to ensure flush top surface with floor surface.
E. Finishing:
   1. Mask off adjacent surfaces before beginning sanding.
   2. Sand flooring to smooth even finish with no evidence of sander marks. Take precautions to contain dust. Remove dust by vacuum.
   3. Apply finish in accordance with floor finish manufacturer's and MFMA instructions.
   4. Apply filler and three finish coats.
   5. Apply first coat, allow to dry, then buff lightly with steel wool to remove irregularities. Vacuum clean and wipe with damp cloth before applying succeeding coat.
   6. Lightly buff between coats with steel wool and vacuum clean before applying succeeding coat.
   7. Apply last coat of finish.

3.04 CLEANING
A. Clean and polish floor surfaces in accordance with floor finish manufacturer's instructions.

3.05 PROTECTION
A. Prohibit traffic on floor finish for 48 hours after installation.
B. Place protective coverings over finished floors; do not remove coverings until Date of Substantial Completion.

END OF SECTION 09.64.29
SECTION 09.65.00
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Resilient sheet flooring.
   B. Resilient tile flooring.
   C. Resilient base.
   D. Resilient stair accessories.
   E. Installation accessories.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
   C. Shop Drawings: Indicate seaming plan.
   D. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
   E. Concrete Testing Standard: Submit a copy of ASTM F710.
   F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
   G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.05 DELIVERY, STORAGE, AND HANDLING
   A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
   B. Store all materials off of the floor in an acclimatized, weather-tight space.
   C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
   D. Protect roll materials from damage by storing on end.
   E. Do not double stack pallets.
1.06 FIELD CONDITIONS
A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 SHEET FLOORING
A. Vinyl Sheet Flooring: Heterogenous without backing.
   1. Minimum Requirements: Comply with ASTM F1913.
   2. Total Thickness (Wear Layer Thickness): 0.080 inch nominal.
   4. Pattern: Wood look or equal pattern.
B. Welding Rod: Solid bead in material compatible with flooring, produced by flooring manufacturer for heat welding seams, and in color matching field color.
C. Vinyl Welding Rod: Solid vinyl bead produced by manufacturer of vinyl flooring for heat welding seams, in color matching field color.

2.02 TILE FLOORING
A. Rubber Tile: Type I- Homogeneous, color and pattern throughout thickness; Type II- Heterogeneous, laminated.
   1. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
   2. Design: Hammered or Slate.
   3. Size: 12 by 12 inch.
   4. Total Thickness: 0.125 inch.
   5. Pattern: __________.
B. Feature Strips: Of same material as tile, ____ inch wide.

2.03 STAIR COVERING
A. Stair Treads: Rubber; full width and depth of stair tread in one piece; tapered thickness.
   1. Nominal Thickness: 0.1875 inch.
B. Stair Risers: Full height and width of tread in one piece, matching treads in material and color.
   1. Thickness: 0.080 inch.
C. Stair Stringers: Full height in one piece and in maximum available lengths, matching treads in material and color.
   1. Thickness: 0.080 inch.

2.04 RESILIENT BASE
A. Resilient Base: ASTM F1861, Type RB rubber, vulcanized thermoset; top set Style B, Cove.
   1. Height: 4 inch.
   2. Thickness: 0.125 inch thick.
   4. Color: Color as selected from manufacturer's standards.

2.05 ACCESSORIES
A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

C. Moldings, Transition and Edge Strips: Same material as flooring.

D. Sealer and Wax: Types recommended by flooring manufacturer.

E. Sound Control Underlayment: Membrane consisting of cork granules and ground ethylene vinyl acetate (EVA) with polyurethane binder.
   1. Thickness: 0.08 inch.
   2. Width: 48 inch.
   3. Length: 50 ft.
   4. Minimum of 55 dB transmission loss when tested in accordance with ASTM E90 or ASTM E492.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
   1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

C. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.

C. Prohibit traffic until filler is fully cured.

D. Clean substrate.

E. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of sub-floor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Spread only enough adhesive to permit installation of materials before initial set.

D. Fit joints and butt seams tightly.

E. Set flooring in place, press with heavy roller to attain full adhesion.

F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
   1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
   2. Resilient Strips: Attach to substrate using adhesive.

H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

I. Install flooring in recessed floor access covers, maintaining floor pattern.

J. Install feature strips where indicated.
3.04 SHEET FLOORING
   A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns carefully at seams.
   B. Seams are prohibited in bathrooms, kitchens, toilet rooms, and custodial closets.
   C. Cut sheet at seams in accordance with manufacturer's instructions.
   D. Seal seams by heat welding where indicated.
   E. Chemically bond seams using seam sealer where indicated.

3.05 TILE FLOORING
   A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.06 RESILIENT BASE
   A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
   B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
   C. Install base on solid backing. Bond tightly to wall and floor surfaces.
   D. Scribe and fit to door frames and other interruptions.

3.07 STAIR COVERINGS
   A. Install stair coverings in one piece for full width and depth of tread.
   B. Install stringers configured tightly to stair profile.
   C. Adhere over entire surface. Fit accurately and securely.

3.08 CLEANING
   A. Remove excess adhesive from floor, base, and wall surfaces without damage.
   B. Clean in accordance with manufacturer's written instructions.

3.09 PROTECTION
   A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 09.65.00
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Resilient tile flooring.
   B. Installation accessories:
      1. Adhesives and adhesive encapsulators.
      2. Finishes and cleaners.

1.02 RELATED REQUIREMENTS
   A. Section 07.92.00 - Joint Sealants.

1.03 REFERENCE STANDARDS
   J. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
X. NSF 332 - Sustainability Assessment for Resilient Floor Coverings; 2015.
Z. NSF 332 - Sustainability Assessment for Resilient Floor Coverings; 2012.

1.04 SUBMITTALS
A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings.
C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
D. Verification Samples: Submit two samples, 4 by 4 inch in size illustrating color and pattern for each resilient flooring product specified.

1.05 DELIVERY, STORAGE, AND HANDLING
A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
B. Store all materials flat off of the floor in an acclimatized, weather-tight space between 65 to 85 degrees F.
C. Do not double stack pallets.

1.06 FIELD CONDITIONS
A. Acclimate material at jobsite between 65 to 85 degrees F and 35 percent to 85 percent relative humidity for 48 hours prior to installation. Temperature and relative humidity should also be maintained at the same levels during installation, and after installation.
B. Spread unopened cartons no more than 6 cartons high and at least 4 inches apart.
C. Keep away from heating and cooling ducts and direct sunlight.
D. If permanent HVAC is not operational, temporary means should be used to maintain the recommended temperature and relative humidity levels.
E. Close areas to traffic during installation of flooring and accessories.

1.07 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.
B. Installer Qualifications: Aspecta™ Five should only be installed by professional flooring mechanics that have demonstrated successful installations of jobs in similar size and scope.

100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
PART 2 PRODUCTS

2.01 RESILIENT TILE FLOORING

A. Luxury Vinyl Plank and Tile:
   1. Pattern: See Finish Legend.
   3. Physical Properties:
      a. Construction: Solid plank and tile made from 100 percent virgin vinyl.
      b. Wear Layer Thickness: 28 mil.
      c. Total Thickness (Gauge): 0.126 inch.
   4. Manufacturing, Performance, and Safety Standards:
      a. NSF 332 Certified: Platinum level.
      b. ASTM F1700, Classification: Class III, Type B.
      c. ASTM F386, Thickness: Passed requirements.
      d. ASTM F410, Wear Layer Thickness: Passed requirements for commercial classification.
      e. ASTM F2421/F2055, Size and Squareness: Passed requirements.
      f. ASTM F1914, Residual Indentation: Exceeds requirements.
      g. ASTM F137, Flexibility: Exceeds requirements.
      h. ASTM F2199, Dimensional Stability: Exceeds requirements.
      i. ASTM F925, Chemical Resistance: Exceeds requirements.
      j. ASTM F1514, Resistance to Heat: Exceeds requirements.
      k. ASTM F1515, Resistance to Light: Exceeds requirements.
      l. ASTM E648/NFPA 253, Critical Radiant Flux: Class I.
      m. ASTM E662, Smoke Density (Flaming and Non-Flaming): Passed requirements.
      n. ASTM F963, Sec. 4.3.5.2(2)(B), Heavy Metals: Passed requirements.
      o. ASTM D6329 and UL 2824, Mold and Microbial Resistance: Highly resistant.
      p. ASTM D2047, Coefficient of Friction (Dry): Exceeds requirements.
      q. ASTM F970, Static Load Limit: Greater than or equal to 1,000 pounds (exceeds requirements).
      r. ASTM D4060, Abrasion Resistance: Average of 30,000 cycles (results vary with emboss).

2.02 ACCESSORIES

A. Moldings, Transition and Edge Strips: Same material as flooring.

PART 3 EXECUTION

3.01 EXAMINATION

A. Install flooring and accessories after other operations (including painting) have been completed.
B. Acceptance of Conditions: Carefully examine all installation areas with installer/applicator present, for compliance with requirements affecting work performance.
   1. Verify that field measurements, product, adhesives, substrates, surfaces, structural support, tolerances, levelness, temperature, humidity, moisture content level, pH, cleanliness and other conditions are as required by the manufacturer, and ready to receive work.
C. Verify that substrate is contaminant-free, including old adhesives and abatement chemicals.
D. Test substrates as required by manufacturer to verify proper conditions exist.
   1. Concrete:
      a. Check for concrete additives such as fly ash, curing compounds, hardeners, or other surface treatments that may prevent proper bonding of floor coverings.
      b. Moisture testing: Perform either the In-Situ Relative Humidity (RH) test (ASTM F2170) or Moisture Vapor Emission Rate (MVER) test (ASTM F1869). Refer to the Manufacturer's
3.01 PREPARATION

A. Prior to installation, the flooring installer should plan and attend an on-site construction meeting with the General Contractor, Architect and Property Owner to review all requirements and inspect site conditions as outlined in the manufacturer's installation document, as well as to review the requirements of ASTM F710 and any relevant building codes, or local, state, or national regulations.

B. Flooring installation should not begin until all site conditions have been assessed, testing has been completed and subfloor conditions are approved.

C. Prepare per manufacturer's written instructions, Section 01.70.00, and as follows:
   1. Prepare substrates to ensure proper adhesion of Luxury Vinyl Plank & Tile.
   2. Concrete Substrates: Prepare substrate per ASTM F710.
      a. Verify that subfloor is clean, flat, smooth, free of dirt, rust, paint, oil, wax or any contaminant that will interfere with adhesive bonding.
      b. Mechanically remove substrate coatings that are not compatible with adhesives, such as sealers, curing, hardening or parting compounds, soap, wax, oil, etc.
         1) Do not use solvents or adhesive removers.
      c. Expansion joints, isolation joints, or other moving joints must be honored and not be filled with underlayment products or other materials, and floor coverings must not be laid over them. Expansion joint covering systems should be detailed by the architect or engineer based upon intended usage and aesthetic considerations.
      d. Surface cracks, grooves, depressions, control joints or other non-moving joints, and other irregularities shall be filled or smoothed with high quality Portland cement or calcium aluminate based patching or underlayment compound for filling or smoothing, or both.
         1) Do not skim-coat large areas with patching compound, especially slick power-troweled surfaces.
         2) Sand smooth per manufacturer's instructions.
      e. Slick surfaces such as power troweled concrete shall be profiled as needed to allow for a mechanical bond between the adhesive and subfloor.
      f. Do not use gypsum-based underlayment products and do not skim coat concrete subfloors.
      g. Self-Leveling Underlayments: Provide a dry and smoothly-sanded underlayment substrate ready for installation of Luxury Vinyl Plank & Tile. Underlayment compound shall be moisture-resistant, mildew-resistant, and alkali-resistant and must have a minimum of 3,000 psi compressive strength per ASTM C109/C109M.
      h. Lightweight concrete shall have a compressive strength greater than 90 pounds per cubic foot with minimum compression strength of 2,500 psi or greater.

3.03 INSTALLATION

A. Installation per manufacturer's written instructions and as follows:
   1. Layout shall be specified by Architect, Designer or End User.
   2. Follow layout and ensure installation reference lines are square.
   3. Field tiles shall be installed with directional arrows on back aligned in the same direction, or may be installed in quarter-turned fashion.
   4. Check cartons for and do not mix dye lots.
   5. Expansion Joints: Locate expansion, isolation, and other moving joints prior to installation.
a. Do not fill expansion, isolation, and other moving joints with patching compound or cover with resilient flooring.
b. Install movement joint systems per manufacturer's instructions and per Section 07.92.00.

6. Adhesives: Adhere flooring to substrate using the full spread method resulting in a completed installation without gaps, voids, raised edges, bubbles or any other surface imperfections.
   a. Select appropriate adhesive, trowel and follow manufacturer's instructions.
   b. Periodically spot-check transfer of adhesive to back of tile during installation.
   c. Roll floor with a 100 pound roller to ensure proper transfer of adhesive and bonding.
   d. Protect floor from traffic per manufacturer's instructions.
   e. Do not wet mop floor until the adhesive has properly set per written instructions.

3.04 FIELD QUALITY CONTROL
   A. Site tests and inspections:
      1. Inspect flooring installation for non-conforming work including, but not limited to, the following:
         a. Lack of adhesion.
         b. Bubbles, loose tiles or raised edges.
         c. Dirt and debris underneath flooring.
         d. Excessive gaps.
         e. Improper substrate preparation as indicated by telegraphing.
         f. Damage to tiles, including: dents/indentations, cuts, cracks, burns or punctures.
   B. Non-conforming work per General Conditions and as follows:
      1. Repair or replace damaged material if not acceptable to the Architect.

3.05 CLEANING
   A. Provide progress cleaning per manufacturer's written instructions, Section 01.70.00, and as follows:
      1. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the work.
         a. Clean and protect completed construction until Date of Substantial Completion.
         b. During installation, remove wet adhesive from surface of flooring per manufacturer's instructions.
      2. Site: Maintain project site free of waste materials and debris.
   B. Provide final cleaning immediately prior to Date of Substantial Completion inspection per manufacturer's written instructions and Section 01.70.00.
      1. Protection: Remove manufacturer's and other installed protection immediately prior to Date of Substantial Completion inspection, unless required otherwise.
      2. Clean floor with a neutral 6-8 pH cleaner.

3.06 MAINTENANCE
   A. Initial maintenance per flooring manufacturer’s written instructions and as follows:
      1. Allow the adhesive to cure for at least 48 hours prior to wet cleaning the floor.
      2. Sweep, dust mop or vacuum the floor thoroughly to remove all loose dirt, dust, grit and debris.
      3. Remove any dried adhesive residue from the surface with Black Scuff and Adhesive Remover or mineral spirits applied to a clean, lint-free cloth.
      4. Damp mop the floor using a cleaner recommended by the flooring manufacturer.
      5. If necessary, scrub the floor using an auto scrubber or rotary machine (300 rpm or less) with a cleaner recommended by the flooring manufacturer. Maintain the proper dilution ratio and use the appropriate scrubbing brush or pad.
      6. Thoroughly rinse the entire floor with fresh, clean water. Remove the dirty residue with a wet-vacuum or clean mop and allow the floor to dry completely.
3.07 PROTECTION

A. Protect materials from construction operations until Date of Substantial Completion or Owner occupancy, whichever occurs first.

   1. Protect finished floor from abuse and damage by using heavy non-staining kraft paper, drop cloths or equivalent. Use additional, non-damaging protective materials as needed.

   2. Light foot traffic on a newly installed floor can be permitted after 24 hours.

   3. Keep heavy traffic and rolling loads off the newly installed LVT flooring for 48 hours.

   4. Protect the floor from rolling traffic by covering with protective boards.

END OF SECTION 09.65.19
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Carpet tile, fully adhered.
   B. Matching roll carpet for direct glue installation on base and stairs.

1.02 RELATED REQUIREMENTS

1.03 PRICE AND PAYMENT PROCEDURES
   A. Section 01.21.00 - Allowances: Cash allowances affecting this section.

1.04 REFERENCE STANDARDS
   A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.

1.05 SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
   C. Shop Drawings: Indicate layout of joints.
   D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
   E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
   F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
   G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
      1. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.06 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
   B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.07 FIELD CONDITIONS
   A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.01 MATERIALS
   A. Tile Carpeting: Tufted, manufactured in one color dye lot.

2.02 ACCESSORIES
   A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.
B. Edge Strips: Embossed aluminum, color as selected by Architect.
C. Adhesives:
   1. Compatible with materials being adhered; maximum VOC content of 50 g/L; CRI (GLP) certified; in lieu of labeled product, independent test report showing compliance is acceptable.
D. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.
C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and pH.
   1. Test in accordance with ASTM F710.
   2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION
A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
D. Vacuum clean substrate.

3.03 INSTALLATION
A. Starting installation constitutes acceptance of sub-floor conditions.
B. Install carpet tile in accordance with manufacturer's instructions.
C. Blend carpet from different cartons to ensure minimal variation in color match.
D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
F. Locate change of color or pattern between rooms under door centerline.
G. Fully adhere carpet tile to substrate.
H. Trim carpet tile neatly at walls and around interruptions.
I. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING
A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
B. Clean and vacuum carpet surfaces.

END OF SECTION 09.68.13
SECTION 09.91.13
EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Surface preparation.
   B. Field application of paints, stains, and varnishes.
   C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
      1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
      2. Exposed surfaces of steel lintels and ledge angles.
      3. Mechanical and Electrical:
         a. On the roof and outdoors, paint equipment that is exposed to weather or to view, including factory-finished materials.
   D. Do Not Paint or Finish the Following Items:
      1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
      2. Items indicated to receive other finishes.
      3. Items indicated to remain unfinished.
      4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
      5. Non-metallic roofing and flashing.
      7. Marble, granite, slate, and other natural stones.
      8. Floors, unless specifically indicated.
      9. Ceramic and other types of tiles.
      11. Exterior insulation and finish system (EIFS).
      13. Concrete masonry units in utility, mechanical, and electrical spaces.
      14. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS
   A. Section 05.50.00 - Metal Fabrications: Shop-primed items.
   B. Section 05.51.00 - Metal Stairs: Shop-primed items.
   C. Section 09.91.23 - Interior Painting.

1.03 DEFINITIONS
   A. Conform to ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS
   C. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2012).
E. SSPC-SP 1 - Solvent Cleaning; 2015.
G. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
H. SSPC-SP 13 - Surface Preparation of Concrete; (Reaffirmed 2015); 2003.

1.05 SUBMITTALS
A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
   3. Manufacturer's installation instructions.
   4. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.
C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.
   2. Where sheen is not specified, submit each color in each sheen available.
   3. Allow 30 days for approval process, after receipt of complete samples by Architect.
   4. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, have been approved.
D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
E. Manufacturer's Instructions: Indicate special surface preparation procedures.
F. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
   2. Label each container with color in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years experience and approved by manufacturer.

1.07 MOCK-UP
A. Provide door and frame assembly illustrating paint color, texture, and finish.
B. Locate where directed by Architect.
C. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING
A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

E. Minimum Application Temperature for Varnish Finishes: 65 degrees F for exterior, unless required otherwise by manufacturer's instructions.

F. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.

1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.

2. Supply each paint material in quantity required to complete entire project's work from a single production run.

3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:

1. Provide paints and finishes that comply with the most stringent requirements specified in the following:


   b. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; www.otcair.org; specifically:

      1) Opaque, Flat: 50 g/L, maximum.

      2) Opaque, Nonflat: 150 g/L, maximum.

      3) Opaque, High Gloss: 250 g/L, maximum.

      4) Varnishes: 350 g/L, maximum.

   c. Architectural coatings VOC limits of Tennessee.

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Colors: To be selected from manufacturer's full range of available colors.

1. Selection to be made by Architect after award of contract.
2.02 PAINT SYSTEMS - EXTERIOR

A. Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including concrete, concrete masonry units, brick, fiber cement siding, primed wood, and primed metal.
   1. Two top coats and one coat primer.
   2. Top Coat(s): Exterior Alkyd Enamel.

B. Stain on Wood:
   1. 2 coats stain.

C. Wood, Opaque, Alkyd, 3 Coat:
   1. One coat of alkyd primer sealer.
   2. Gloss: Two coats of alkyd enamel.

D. Concrete/Masonry, Opaque, Alkyd, 3 Coat:
   1. One coat of block filler.

E. Exterior Gypsum Board and Exterior Plaster, Opaque, Alkyd, 3 Coat:
   1. One coat of alkyd primer sealer.
   2. Flat: Two coats of alkyd enamel.

F. Ferrous Metals, Unprimed, Alkyd, 3 Coat:
   1. One coat of alkyd primer.

G. Ferrous Metals, Primed, Alkyd, 2 Coat:
   1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
   2. Gloss: Two coats of alkyd enamel.

H. Galvanized Metals, Alkyd, 3 Coat:
   1. One coat galvanize primer.
   2. Gloss: Two coats of alkyd enamel.

I. Pavement Marking Paint:
   1. White: Two coats, with reflective particles.

2.03 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
   1. Interior/Exterior Latex Block Filler.
   2. Anti-Corrosive Alkyd Primer for Metal.
   3. Alkyd Primer for Galvanized Metal.
   4. Alkyd/Oil Primer for Exterior Wood.

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.
B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

E. Test shop-applied primer for compatibility with subsequent cover materials.

F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Exterior Plaster and Stucco: 12 percent.
   2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
   3. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.
   4. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
   2. Clean concrete according to ASTM D4258. Allow to dry.
   3. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.

G. Masonry:
   1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
   2. Prepare surface as recommended by top coat manufacturer.
   3. Clean surfaces with pressurized water. Use pressure range of 600 to 1500 psi at 6 to 12 inches. Allow to dry.


J. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
   2. Prepare surface according to SSPC-SP 2.

K. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

L. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.

M. Exterior Wood to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior calking compound after sealer has been applied. Prime concealed surfaces.

N. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.

C. Apply products in accordance with manufacturer's written instructions.

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance.

F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.

G. Sand wood and metal surfaces lightly between coats to achieve required finish.

H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

I. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

J. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 09.91.13
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Surface preparation.
   B. Field application of paints, stains, and varnishes.
   C. Materials for backpriming woodwork.
   D. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
      1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
      2. Elevator pit ladders.
      3. Prime surfaces to receive wall coverings.
      4. Mechanical and Electrical:
         a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
         b. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
         c. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
   E. Do Not Paint or Finish the Following Items:
      1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
      2. Items indicated to receive other finishes.
      3. Items indicated to remain unfinished.
      4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
      5. Floors, unless specifically indicated.
      7. Glass.
      8. Concrete masonry units in utility, mechanical, and electrical spaces.
      9. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS
   A. Section 05.50.00 - Metal Fabrications: Shop-primed items.
   B. Section 09.91.13 - Exterior Painting.

1.03 DEFINITIONS
   A. Conform to ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS
   C. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2012).
F. SSPC-SP 1 - Solvent Cleaning; 2015.
G. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
H. SSPC-SP 13 - Surface Preparation of Concrete; (Reaffirmed 2015); 2003.

1.05 SUBMITTALS
A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
   3. Manufacturer's installation instructions.
   4. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.
C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.
   2. Where sheen is not specified, submit each color in each sheen available.
   3. Allow 30 days for approval process, after receipt of complete samples by Architect.
   4. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, have been approved.
D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01.60.00 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
   3. Label each container with color in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years experience and approved by manufacturer.

1.07 MOCK-UP
A. See Section 01.40.00 - Quality Requirements, for general requirements for mock-up.
B. Provide door and frame assembly illustrating paint color, texture, and finish.
C. Locate where directed by Architect.
D. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING
A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS
A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
C. Do not apply materials when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.
D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.
E. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior, unless required otherwise by manufacturer's instructions.
F. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 PAINTS AND FINISHES - GENERAL
A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
   4. Supply each paint material in quantity required to complete entire project's work from a single production run.
   5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
B. Volatile Organic Compound (VOC) Content:
   1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
      b. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; www.otcair.org; specifically:
         1) Opaque, Flat: 50 g/L, maximum.
         2) Opaque, Nonflat: 150 g/L, maximum.
         3) Opaque, High Gloss: 250 g/L, maximum.
         4) Varnishes: 350 g/L, maximum.
      c. Architectural coatings VOC limits of Tennessee.
   2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
D. Colors: To be selected from manufacturer's full range of available colors.
   1. Selection to be made by Architect after award of contract.
2. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
3. Extend colors to surface edges; colors may change at any edge as directed by Architect.
4. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.
5. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color coding scheme indicated.

2.02 PAINT SYSTEMS - INTERIOR

A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, brick, wood, plaster, uncoated steel, shop primed steel, galvanized steel, and aluminum.
   1. Two top coats and one coat primer.
   2. Top Coat(s): High Performance Architectural Interior Latex.
   3. Primer: As recommended by top coat manufacturer for specific substrate.

B. Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
   1. Two top coats and one coat primer.
   2. Top Coat(s): High Performance Architectural Interior Latex.

C. Medium Duty Vertical and Overhead: Including gypsum board, plaster, concrete, concrete masonry units, uncoated steel, shop primed steel, galvanized steel, and aluminum.
   1. Two top coats and one coat primer.
   2. Top Coat(s): High Performance Architectural Interior Latex.
   3. Primer: As recommended by top coat manufacturer for specific substrate.

D. Transparent Finish on Wood.
   2. Top Coat(s): Polyurethane Varnish, Oil Modified.

E. Transparent Finish on Wood Floors:
   1. 2 top coats over stain.
   3. Top Coat(s): Polyurethane Varnish, Oil Modified.

F. Concrete/Masonry, Opaque, Latex, 3 Coat:
   1. One coat of block filler.
   2. Semi-gloss: Two coats of latex enamel.

G. Ferrous Metals, Unprimed, Alkyd, 3 Coat:
   1. One coat of alkyd primer.
   2. Gloss: Two coats of alkyd enamel.

H. Ferrous Metals, Primed, Latex, 2 Coat:
   1. Touch-up with latex primer.
   2. Gloss: Two coats of latex enamel.

I. Galvanized Metals, Alkyd, 3 Coat:
   1. One coat galvanize primer.
   2. Gloss: Two coats of alkyd enamel.

J. Gypsum Board/Plaster, Latex, 3 Coat:
   1. One coat of alkyd primer sealer.
   2. Eggshell: Two coats of latex enamel.

2.03 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
1. Interior/Exterior Latex Block Filler.
2. Interior Latex Primer Sealer.
3. Interior Rust-Inhibitive Water Based Primer.
4. Alkyd Primer for Galvanized Metal.
5. Latex Primer for Interior Wood.

2.04 ACCESSORY MATERIALS
A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
B. Patching Material: Latex filler.
C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION
A. Do not begin application of paints and finishes until substrates have been properly prepared.
B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
E. Test shop-applied primer for compatibility with subsequent cover materials.
F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Plaster and Stucco: 12 percent.
   3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
   4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
   5. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION
A. Clean surfaces thoroughly and correct defects prior to application.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
D. Seal surfaces that might cause bleed through or staining of topcoat.
E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
F. Concrete:
   1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
   2. Clean concrete according to ASTM D4258. Allow to dry.
   3. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
G. Masonry:
1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer’s written instructions. Allow to dry.

2. Prepare surface as recommended by top coat manufacturer.

H. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.


J. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

K. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

L. Galvanized Surfaces:

M. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

N. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

O. Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer’s written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

F. Sand wood and metal surfaces lightly between coats to achieve required finish.

G. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

H. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
### Protection

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

**END OF SECTION 09.91.23**
SECTION 10.14.00
SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Room and door signs.
B. Interior directional and informational signs.
C. Emergency evacuation maps.
D. Building identification signs.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
B. All signage, interior and exterior shall comply with ETSU's currently adopted standard signage design standards. In the event there is a discrepancy between the standard signage standards and the following specification information, the standard signage standards shall be the option used.

C. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.

D. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
1. When room numbers to appear on signs differ from those on the drawings, include the drawing room number on schedule.
2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
3. Submit for approval by Owner through Architect prior to fabrication.

E. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
F. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
G. Verification Samples: Submit samples showing colors specified.
H. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.05 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Package signs as required to prevent damage before installation.
B. Package room and door signs in sequential order of installation, labeled by floor or building.
C. Store tape adhesive at normal room temperature.

1.07 FIELD CONDITIONS
A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 SIGNAGE APPLICATIONS
A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
   1. Sign Type: Flat signs with applied character panel media as specified.
   2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
   3. Character Height: 1 inch.
   4. Sign Height: 6 inches, unless otherwise indicated.
   5. Office Doors: Identify with room numbers to be determined later, not the numbers shown on the drawings; in addition, provide "window" section for replaceable occupant name.
   6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers shown on the drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
   7. Service Rooms: Identify with room names and numbers to be determined later, not those shown on the drawings.
   8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
   9. Background color shall be Rowmark 311-504 Airforce Blue; Text color shall be White.
C. Interior Directional and Informational Signs:
   1. Sign Type: Same as room and door signs.
D. Emergency Evacuation Maps:
   1. Allow for one map per elevator lobby.
E. Building Identification Signs:
   1. Use individual 3" metal letters.
F. Traffic Signs: To match campus standards; locate where indicated on the drawings.

2.02 SIGN TYPES
A. Flat Signs: Signage media without frame.
   1. Edges: Square.
   2. Corners: Square.
B. Color and Font: Unless otherwise indicated:
   1. Character Font: Helvetica, Arial, or other sans serif font.
   2. Character Case: Upper case only.

2.03 TACTILE SIGNAGE MEDIA
A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
1. Total Thickness: 1/16 inch.

B. Applied Character Panels: Acrylic plastic base, with applied acrylic plastic letters and braille.
   1. Total Thickness: 1/8 inch.

2.04 DIMENSIONAL LETTERS

A. Metal Letters:
   1. Mounting: Concealed screws.

2.05 ACCESSORIES

A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install neatly, with horizontal edges level.
C. Locate signs where indicated:
   1. Room and Door Signs: Locate on wall at latch side of door with centerline of sign at 60 inches above finished floor.
D. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION 10.14.00
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Solid plastic toilet compartments.
B. Urinal and vestibule screens.

1.02 RELATED REQUIREMENTS
A. Section 05.12.00 - Structural Steel Framing: Concealed steel support members.
B. Section 05.50.00 - Metal Fabrications: Concealed steel support members.
C. Section 06.10.00 - Rough Carpentry: Blocking and supports.
D. Section 10.28.00 - Toilet, Bath, and Laundry Accessories.

1.03 REFERENCE STANDARDS
A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.05 SUBMITTALS
A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
C. Product Data: Provide data on panel construction, hardware, and accessories.
D. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Solid Plastic Toilet Compartments:
   2. Substitutions: Section 01 25 13 - Product Substitution Procedures.

2.02 SOLID PLASTIC TOILET COMPARTMENTS
A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286, floor-mounted headrail-braced.
   1. Color: To Be Determined.
B. Doors:
   1. Thickness: 1 inch.
   2. Width: 24 inch.
   4. Height: 55 inch.
C. Panels:
   1. Thickness: 1 inch.
   2. Height: 55 inch.
   3. Depth: As indicated on drawings.

D. Pilasters:
   1. Thickness: 1 inch.
   2. Width: As required to fit space; minimum 3 inch.

E. Screens: Without doors; to match compartments; mounted to wall with two panel brackets.

2.03 ACCESSORIES
A. Pilaster Shoes: Formed ASTM A666, Type 304 stainless steel with No. 4 finish, 3 in high, concealing floor fastenings.
B. Head Rails: Hollow stainless steel, 1 by 1-1/2 inch size, with anti-grip profile and cast socket wall brackets.
C. Pilaster Brackets: Polished stainless steel.
D. Wall Brackets: Continuous type, polished stainless steel.
E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
F. Hardware: Natural anodized aluminum:
   1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
   2. Door Latch: Slide type with exterior emergency access feature.
   3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
   4. Coat hook with rubber bumper; one per compartment, mounted on door.
   5. Provide door pull for outswinging doors.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify that field measurements are as indicated.
B. Verify correct spacing of and between plumbing fixtures.
C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION
A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
B. Maintain 3/8 to 1/2 inch space between wall and panels and between wall and end pilasters.
C. Attach panel brackets securely to walls using anchor devices.
D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES
A. Maximum Variation From True Position: 1/4 inch.
B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING
A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.

C. Adjust adjacent components for consistency of line or plane.

END OF SECTION 10.21.13.19
SECTION 10.26.01
WALL AND CORNER GUARDS

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Corner guards.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Indicate physical dimensions, features, anchorage details, and rough-in measurements.
   C. Samples: Submit two sections of bumper rail, 24 inch long, illustrating component design, configuration, color and finish.
   D. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.

PART 2 PRODUCTS

2.01 COMPONENTS
   A. Corner Guards - Surface Mounted: Extruded one-piece unit without splices, installed with adhesive.
      1. Material: Polyethylene terephthalate (PET or PETG); PVC-free; smooth surface.
      2. Width of Wings: 2 inches.
      3. Color: As selected from manufacturer's standard colors.
      4. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with 1.
      5. Thickness: 18 gage, 0.05 inch.

2.02 FABRICATION
   A. Fabricate components with tight joints, corners and seams.
   B. Pre-drill holes for attachment.
   C. Form end trim closure by capping and finishing smooth.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
   B. Verify that field measurements are as indicated on Drawings.

3.02 INSTALLATION
   A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall framing members only.
   B. Position corner guard 4 inches above finished floor to ceiling.
   C. Coordinate installation of vinyl fabric wall covering with corner guard frame and cover.
3.03 TOLERANCES

A. Maximum Variation From Required Height: 1/4 inch.

B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

END OF SECTION 10.26.01
PART 1  GENERAL

1.01  SECTION INCLUDES

A. Accessories for toilet rooms and utility rooms.
B. Manual roll paper towel dispensers.
C. Grab bars.

1.02  RELATED REQUIREMENTS

1.03  REFERENCE STANDARDS


1.04  ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.05  SUBMITTALS

A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2  PRODUCTS

2.01  MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
B. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

2.02  FINISHES

A. Stainless Steel: No. 4 Brushed finish, unless otherwise noted.
B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.
C. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.
D. Galvanizing for Items Other than Sheet: Comply with ASTM A123/A123M; galvanize ferrous metal and fastening devices.
E. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
F. Back paint components where contact is made with building finishes to prevent electrolysis.

2.03 TOILET ROOM ACCESSORIES

A. Toilet Paper Dispenser: three roll, surface mounted Opticore technology in the Revolution dispenser, 14 1/"W x 14 9/16"H x 6 5/16"D, Color: Black.
   1. Von Drehle Roll Towel Dispenser; #DISP 8861
   2. Paper Discharge: Low pull force with stub roll feature.
   3. Capacity: 8 inch diameter roll.
C. Electric Dryers: Traditional fan-in-case type, with downward nozzle.
   2. Style: Traditional horizontal, rectangular case, fixed nozzle.
      a. Tamper-resistant screw attachment of cover to mounting plate.
   5. Air Velocity: 15,000 linear feet per minute, minimum.
   6. Total Wattage: 500 W, maximum; no heater.
   7. Runtime: Field adjustable or automatic, up to 35 seconds.
   8. Warranty: 3 years.
D. Soap Dispenser: Soap lather dispenser, wall-mounted, surface, with Chrome Border cover and horizontal stainless steel tank and working parts; push type soap valve, check valve, and window gage refill indicator.
   1. Product: Proline 1 Liter manufactured by DEB USA. (704) 263-4240
E. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
F. Grab Bars: Stainless steel, nonslip grasping surface finish.
   1. Standard Duty Grab Bars:
      a. Push/Pull Point Load: 250 pound-force, minimum.
      b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
      c. Length and Configuration: As indicated on drawings.
   2. Heavy Duty Grab Bars: Floor supports are acceptable if necessary to achieve load rating.
      a. Push/Pull Point Load: Minimum 1000 pound-force, minimum.
      b. Dimensions: 1-1/2 inch outside diameter, minimum 0.125 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
      c. Length and Configuration: As indicated on drawings.
G. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
H. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
   1. Style: Horizontal.
2.04 UTILITY ROOM ACCESSORIES
   A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
      1. Mop/broom holders: 3 spring-loaded rubber cam holders at shelf front.
      2. Length: 36 inches.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify existing conditions before starting work.
   B. Verify exact location of accessories for installation.
   C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
   D. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION
   A. Deliver inserts and rough-in frames to site for timely installation.
   B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION
   A. Install accessories in accordance with manufacturers' instructions in locations indicated on the drawings.
   B. Install plumb and level, securely and rigidly anchored to substrate.
   C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.04 PROTECTION
   A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 10.28.00
McCarty Holsaple McCarty, Inc.
East Tennessee State University
ACCESSORIES
TOILET, BATH, AND LAUNDRY
Fine Arts Classroom Building
SBC No. 166/005-08-2013

100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
SECTION 10.44.00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Fire extinguishers.
B. Fire extinguisher cabinets.
C. Accessories.

1.02 RELATED REQUIREMENTS
A. Section 06.10.00 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS
A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, anchorage details, and installation instructions.
C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.05 FIELD CONDITIONS
A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 FIRE EXTINGUISHERS
A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gage.
   2. Size: 10 pound.
   3. Temperature range: Minus 40 degrees F to ___ degrees F.

2.02 FIRE EXTINGUISHER CABINETS
A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
B. Cabinet Construction: Non-fire rated.
   1. Formed primed steel sheet; 0.036 inch thick base metal.
C. Fire Rated Cabinet Construction: One-hour fire rated.
D. Metal: Formed primed steel sheet; 0.036 inch thick base metal.
E. Cabinet Configuration: Semi-recessed type.
F. Door: 0.036 inch thick, reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with continuous piano hinge. Provide nylon catch.
G. Door Glazing: Float glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.

2.03 ACCESSORIES
A. Extinguisher Theft Alarm: Battery operated alarm, 10 second delay for disarming, activated by opening cabinet door.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify existing conditions before starting work.
B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Install cabinets plumb and level in wall openings, 30 inches from finished floor to inside bottom of cabinet.
C. Place extinguishers in cabinets.

END OF SECTION 10.44.00
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Dock bumpers of reinforced rubber with attachment frame.

1.02 RELATED REQUIREMENTS
   A. Section 03.10.00 - Concrete Forming and Accessories: Placement of bumper anchors into concrete.

1.03 SUBMITTALS
   A. Product Data: Indicate unit dimensions, method of anchorage, and details of construction.
   B. Manufacturer's Installation Instructions: Indicate special installation requirements.

PART 2 PRODUCTS

2.01 COMPONENTS
   A. Bumpers: Fabric reinforced rubber pads, ozone resistant, laminated and compressed in position with two galvanized steel rods with threaded ends, washers and nuts; between 3 by 2-1/2 by 1/4 inch galvanized steel angle end plates:
      1. Projection From Wall: 4-1/2 inches.
      2. Vertical Height: 10 inches.
      3. Width: 15 inches.
   B. Attachment Hardware: 3/4 inch diameter galvanized bolts and expansion shields.
   C. Touch-up Primer: Zinc rich type.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that anchor placement is acceptable.

3.02 INSTALLATION
   A. Install dock bumpers in accordance with manufacturer's instructions.
   B. Set plumb and level.
   C. Secure angle end frames to concrete.

END OF SECTION 11.13.13
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Compression door seals.
   B. Stationary dock shelters.

1.02 RELATED REQUIREMENTS

1.03 SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Shop Drawings: Indicate framed wall opening, dimensions and tolerances, adjacent construction and fittings required for anchorages, and anchor points.
   C. Manufacturer's Installation Instructions: Indicate special requirements.
   D. Operation Data: Provide operating instructions, identify unit limitations.
   E. Maintenance Data: Provide unit maintenance information, lubrication cycles, spare parts manual.

PART 2 PRODUCTS

2.01 COMPONENTS
   A. Door Seal: Compressible construction:
      1. Cushion: Closed cell foam for full depth of seal; straight jambs.
      2. Covering Material: Hypalon impregnated waterproof nylon fabric; with supplementary high abrasion resistant wear layer, to remain flexible to -65 degrees F.
      4. Bottom Door Seal: Same construction as above.
   B. Stationary Dock Shelter:
      1. Frame Construction (Top and Sides): Treated wood.
      2. Side and Top Covering Material: Vinyl impregnated waterproof nylon fabric; with supplementary high abrasion resistant wear layer, to remain flexible to minus 65 degrees F.
      3. Top Covering Material: Translucent waterproof nylon fabric; to remain flexible to minus 65 degrees F.
      5. Covering Color: Gray color with 5 inch wide yellow stripe continuous.
      6. Seams: Molded without mechanical stitching; double ply at exposed face.
   C. Fasteners: Galvanized permitting site adjustment and alignment.
   D. Backing Material: Treated plywood.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that rough-in wall opening and anchors are acceptable, correctly sized and aligned to tolerances.
   B. Verify that frames installed in concrete and masonry are correctly located.
3.02 INSTALLATION
   A. Install seal and shelter components in accordance with manufacturer's instructions.
   B. Set plumb and level.
   C. Attach anchors and fittings to prepared wall construction and opening frame.

3.03 ADJUSTING
   A. Adjust installed unit for smooth and balanced operation.

END OF SECTION 11.13.16
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Prefabricated steel leveler.
   B. Operating hardware.
   C. Mechanical restraint safety vehicle lock.

1.02 RELATED REQUIREMENTS
   A. Section 03.10.00 - Concrete Forming and Accessories: Placement of leveler frame and safety lock frame into concrete loading dock.
   B. Section 03.30.00 - Cast-in-Place Concrete: Concrete pit.
   C. Section 11.13.13 - Loading Dock Bumpers.

1.03 SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide materials and finish, installation details, roughing-in measurements, and operation of unit and safety lock device.
   C. Shop Drawings: Indicate required opening dimensions and tolerances, placement dimensions of safety lock device, and perimeter conditions of construction.
   D. Manufacturer's Installation Instructions: Indicate special requirements.
   E. Operation Data: Provide operating instructions, and identify unit limitations.
   F. Maintenance Data: Provide unit maintenance information, lubrication cycles, and spare parts manual.

PART 2 PRODUCTS

2.01 COMPONENTS
   A. Loading Dock Leveler:
      2. Railing: Resists lateral force of 100 lbf without permanent deformation or set.
   B. Vehicle Restraint: Mechanical lock, fabricated and welded steel plate construction, spring loaded to automatically latch when activated, to comply with ICC-ES (Evaluation Service) reports for semitrailer vehicle bumper requirements for dimension and placement indicated.

2.02 ACCESSORIES

2.03 FINISHES
   A. Leveler Platform: Factory enameled finish.
   B. Leveler Frame: Factory enameled finish.
   C. Vehicle Restraint: Yellow painted hook, galvanized steel operating mechanism.
PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that rough-in openings are acceptable.

3.02 INSTALLATION
   A. Install dock leveler and mechanical safety vehicle lock unit in prepared opening in accordance with manufacturer's instructions.
   B. Set square and level.
   C. Anchor unit securely, flush with dock. Weld back of leveling dock to pit frame. Touch-up weld with primer.
   D. Anchor safety lock securely and flush with vertical dock face.

3.03 ADJUSTING
   A. Adjust installed unit and safety device for smooth and balanced operation.

END OF SECTION 11.13.19.13
SECTION 11.31.00
RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Kitchen appliances.
B. Laundry appliances.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS
A. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.
B. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
B. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).

1.05 WARRANTY
A. Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.
B. Provide ten (10) year manufacturer warranty on magnetron tube of microwave ovens.
C. Provide ten (10) year manufacturer warranty on tub and door liner of dishwashers.

PART 2 PRODUCTS

2.01 KITCHEN APPLIANCES
B. Refrigerator: Free-standing, side-by-side, and frost-free.
   1. Capacity: Total minimum storage of 18 cubic ft; minimum 15 percent freezer capacity.
   2. Energy Usage: Minimum 20 percent more energy efficient than energy efficiency standards set by U.S. Department of Energy (DOE).
   3. Features: Include glass shelves, automatic icemaker, and light in freezer compartment.
   4. Exterior Finish: Porcelain enameled steel, color TBD.
C. Microwave: Countertop.
   1. Capacity: 1.3 cubic ft.
   3. Features: Include turntable.
   4. Exterior Finish: TBD.
D. Waste Disposer: Standard type, overload protection, direct wired, dishwasher connection, drain elbow, drain connector, and sound reduction features.
   1. Power: 1/2 HP.
   2. Capacity: Large.
3. Height: 14-1/2 inch.
4. Depth: 8-1/2 inch.
5. Drain Outlet Diameter: 1-1/2 inch.
7. Voltage: 115 volts, 60 Hz, 4 amps.
9. Exterior Finish: TBD.

E. Dishwasher: Undercounter.
   2. Wash Levels: Three (3).
   3. Cycles: Five (5), including normal, rinse and hold, short, china/crystal, and pot and pan.
   4. Features: Include rinse aid dispenser, optional no-heat dry, optional water temperature boost, adjustable upper rack, and adjustable lower rack.
   5. Finish: Porcelain enameled steel, color TBD.

2.02 LAUNDRY APPLIANCES

B. Clothes Washer: Front-loading.
   1. Size: Large capacity.
   2. Controls: Solid state electronic.
   6. Finish: Painted steel, color TBD.
C. Clothes Dryer: Electric, stationary.
   1. Size: Large capacity.
   2. Controls: Solid state electronic, with electronic moisture-sensing dry control.
   3. Temperature Selections: One.
   5. Features: Include interior light, reversible door, stationary rack, sound insulation, and end of cycle signal.
   6. Finish: Painted steel, color TBD.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify utility rough-ins are provided and correctly located.

3.02 INSTALLATION
   A. Install in accordance with manufacturer's instructions.
   B. Anchor built-in equipment in place.

3.03 ADJUSTING
   A. Adjust equipment to provide efficient operation.

3.04 CLEANING
   A. Remove packing materials from equipment and properly discard.
B. Wash and clean equipment.

END OF SECTION 11.31.00
SECTION 11 61 00
PERFORMANCE MACHINERY GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS
A. Division 1 Specification Sections apply to this Section.
B. This section applies to the following sections:
   1. 116133 Performance Manual Rigging.
   2. 116135 Performance Powered Rigging.
   3. 116137 Proscenium Fire Safety Curtain.
   4. 116139 Performance Lifts.
   5. 116143 Performance and Acoustic Drapery.
   6. 116144 Performance Drapery Track.

1.02 DEFINITIONS
A. Manual Rigging refers to mechanical devices that are powered using human effort, power, or energy, to locate elements in horizontal or vertical planes.
B. Powered Rigging refers to mechanical devices that are operated via electro-mechanical devices to locate elements in horizontal or vertical planes.
C. Where measurements are provided, they are stated in Imperial units followed by SI units. Conversions are generally performed as soft conversions, unless a hard equivalent is readily available.

1.03 QUALIFICATIONS:
A. The Contractor shall have been an authorized representative of the manufacturer of not less than one of the specified equipment systems for a minimum of two (2) years.
B. Contractors shall have been involved in the type of work of that section for a period of five (5) years or more and shall have successfully completed at least ten (10) installations in the country in which the work is being performed of this type and scope, which have been in service successfully for not less than two (2) years. Project scope requirements include, but are not limited to, project complexity, project construction cost, and equipment contractor’s construction costs.
C. The right is reserved to inspect previous equipment or systems as furnished or installed by this Contractor. In addition, the right is reserved to reject a Contractor who has failed in any respect to comply with the provisions of previous contracts.
D. No sub-contracting work is permissible, unless the Sub-Contractor is named and included as part of the bid. All terms and requirements herein apply to the Sub-Contractor. The right is reserved to reject the proposed Sub-Contractor based on the terms stated herein.
E. Regardless of whether a Sub-Contractor is accepted and used for installation, the Contractor shall have a person under the Contractor’s Company’s direct employ supervising the installation at all times.
F. Upon request, the contractor shall submit a list of projects of similar size and scope. The Architect is the final judge of suitability of experience.
G. Where overhead rigging is part of the Work, it shall be supervised on site at all times through the entirety of installation and system commissioning by an Entertainment Technician Certification Program (ETCP) Certified Rigger – Theatre, or a licensee of authority having jurisdiction.

1.04 SUBMITTALS
A. Coordination Drawings: Prepare and submit coordination Drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities.
   1. Show the interrelationship of components shown on separate Shop Drawings.
2. Indicate required installation sequences.
3. Refer to Division 1, Division 23 and Division 26 documentation for specific coordination requirements for mechanical and electrical installations.

B. Make changes in the submittals as required, consistent with the Contract Documents. When resubmitting, notify the Architect in writing of any revisions other than those required.
   1. Action indicated is subject to the requirements of the Contract Documents.
   2. Adjustments made on shop drawings are not intended to change the Contract Price. If adjustments affect the value of the Work, state such in writing prior to proceeding with the Work.

C. Shop Drawings
   1. Submit drawings depicting components, systems and assemblies, subject to static, dynamic or electrical loads affecting their safety and operational integrity, or as otherwise required by legislation, signed and sealed for the intended application, by a licensed Professional Engineer experienced in work of similar nature and scope and licensed in the State of installation.
   2. Note and maintain one of the prints returned as a "Record Document".
   3. Do not use Shop Drawings without an appropriate final stamp by the Architect indicating action taken in connection with construction.
   4. Shop Drawings shall establish the actual detail of the Work, indicate proper relation to adjoining work, amplify design details of mechanical and electrical equipment in proper relation to physical spaces in the structure, and incorporate minor changes of design or construction to suit actual conditions.
   5. Submit newly prepared information, drawn to accurate scale.
   6. Highlight, encircle, or otherwise indicate deviations from the Contract Documents.
   7. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.
   8. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings.
   9. Lettering on Shop Drawings is considered part of the Drawings.
10. Shop Drawings include the following plates and schedules:
    a. Assembly, installation and erection plans and diagrams depicting relative locations of various members and overall dimensions with reference to the preliminary drawings including auxiliary structure.
    b. Block schematics of all equipment internal wiring and system element interconnection.
    c. Component equipment drawings from Manufacturer's approved drawings or catalog cuts showing weight, dimensions, and capacities of mechanical components.
    d. Component Equipment Drawings.
    e. Details and assembly drawings.
    f. Dimensions.
    g. Erection Plans and diagrams.
    h. Finishes.
    i. Signage and identification systems.
    j. Identification of products and materials included.
    k. Layout of control consoles, racks and other associated equipment.
    l. Mechanical Assembly Drawings.
    m. Mechanical Detail Drawings.
    n. Miscellaneous details and assembly drawings depicting lengths, widths, and sizes of all members, connection details, location, type and size of bolts, rivets, welds, and other connections together with materials to be used.
    o. Notation of coordination requirements.
    p. Notation of dimensions established by field measurement.
    q. Program logic and relationship to input / output points, either in logic diagrams or ladder logic diagram, or other appropriate format.
r. Riser diagrams showing quantities, coding and sizes of all interconnections between system components.
s. System assemblies, major sub assemblies, components, cabinets and enclosures, including notation of type and manufacturer of switches, relays, locks and hardware.
t. Templates and installation details.
u. Test data on materials components and systems as available for the items specified herein.
v. Wiring Diagrams showing system layout.
w. LCD Screening for motor control systems.

D. Maintenance Manuals
1. Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 2-inch, 3-ring vinyl covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder.
2. Operating and Maintenance Instructions: Provide instruction manuals describing proper operation and maintenance. Include a detailed review of the following items:
a. Maintenance and operation manuals for individual components.
b. Cleaning.
c. Control sequences.
d. Copies of warranties.
e. Emergency instructions.
f. Fixture lamping schedule.
g. Fuse list.
h. Hazards.
i. Identification systems.
j. Inspection procedures.
k. Lubricants.
l. Recommended "turn around" cycles.
m. Spare parts list.
n. Specifications for expendables.
o. Tools.
p. Warranties and bonds.
q. Wiring diagrams reflecting actual labeling in the field.
r. Maintenance agreements and similar continuing commitments.
s. Product Data.
t. As Built drawings depicting actual locations and conditions of the system design, construction and arrangement.

3. As part of instruction for operating equipment, describe the following procedures:
a. Start-up.
b. Operation.
c. Shutdown.
d. Emergency operations.
e. Noise and vibration adjustments.
f. Safety procedures.
g. Economy and efficiency adjustments.
h. Effective energy use.
i. Complete Subcontractor List including names and telephone numbers of persons to contact.

4. Provide copies of documentation as required under Division 1.

5. Unless specified otherwise under Division 1, provide copies of the documentation distributed as follows:
b. Following modifications and corrections based on the review, distribute two (2) corrected hard copies and a digital copy to the Owner.
6. In addition to requirements under Division 1, provide a plan and section of performance machinery device locations in CAD format. Drawings should be saved in Drawing Interchange Format (DXF).

### 1.05 INTERFACE WITH ADJACENT SYSTEMS

A. Systems described shall in no way damage or adversely affect architectural, mechanical, electrical or structural systems, components or construction.

B. Coordinate the system installation with the requirements of adjacent and intersecting Work.

C. Electrical Interface.
   1. Perform electrical work in accordance with governing legislation. Coordinate Work with other trades.
   2. Products furnished for installation by Division 26 contractor.
      a. Faceplate Back Boxes: Gang back boxes, as outlined in the Documents, are not included and are provided under Division 26.
      b. Devices with 100v and above terminations including receptacles, power raceways, faceplates and back boxes.
      c. Power and control raceways
      d. Motor control panels
      e. Control voltage wire and cable, including, but not limited to, specialty cable and standard wire. Control wiring is terminated by Division 11 contractor.
   3. Wire, cable and terminations for 100v and above devices are provided by Division 26.
   4. Conduit connecting control systems in this section with other systems is provided by Division 26.
   5. Power and Control Distribution
      a. See Division 26 documents for base power and control infrastructure locations.
      b. Where manufacturer’s standard system requirements differ from those in the Division 11 & Division 26 documents, coordinate those requirements with the Division 26 contractor without further cost to the project.
      c. It is incumbent on the Division 11 contractor to ensure a properly coordinated and operational system. Discrepancies in requirements should be noted prior to bid.
   6. Delivery
      a. Deliver materials within this contract to the project site.
      b. The Division 26 Contractor is responsible for equipment furnished under Division 11 at such time that the Division 26 Contractor takes possession of the equipment.
         1. At this time the Division 26 Contractor will document the exact condition, breakage or damage evident in the equipment.
         2. Exact quantities will be documented.
         3. Discrepancies in the quantities and damage or unsuitability of the product for the application will be provided in writing to the Division 11 contractor upon transfer of the equipment.
         4. Acceptance of the equipment verifies proper physical condition of the product. Electrical functionality is not implied at acceptance and is not the responsibility of the Division 26 Contractor.
         5. The Division 11 Contractor will be present at the time of transfer to coordinate and expedite this action. The Division 11 Contractor shall be given a two week minimum lead time prior to this meeting.
   7. Supervision Of Installation
      a. Provide instruction and supervision to the Division 26 Contractor as it pertains to the installation of these systems. Provide the necessary qualified personnel for coordination meetings and site visits prior to installation of systems.

D. Follow Drawings in laying out work and checking drawings of other trades to verify spaces in which work is installed. Maintain maximum headroom and space conditions at all locations. Before proceeding with the work, notify Architect where conditions appear inadequate.

E. If directed by the Architect, without extra charge, execute reasonable modifications in the layout needed to prevent conflict with work of other trades or for proper execution of the work.
1.06 SYSTEM DESIGN AND PERFORMANCE REQUIREMENTS

A. Design Requirements:

1. The Contractor's engineer shall perform detailed analysis and design of each element as required to meet the performance and safety requirement expressed by regulation, standards and in the Contract Documents.

2. Operating Mechanisms: Provide operating devices, mechanisms and hardware in connection with this Work to operate smoothly, freely and without excessive noise or friction.

3. Built-In Work: Provide anchor bolts, inserts, plates and any other anchorage devices and all other items specified herein to be built into concrete, masonry or work of other trades, with necessary templates and instructions. Provide such devices in ample time to facilitate proper placing and installation.

4. Supplementary Parts: Provide as necessary to complete each item of work, even in the event that such supplementary parts are not specifically mentioned in the Contract Documents.

5. Design and perform the mechanical installations to possess the necessary properties to withstand stresses of tension, compression, flexure, shear, and torsion which may be anticipated being imposed on one or more of the components. Conform to the following priorities of installation: 1) safety, 2) ease of operation, 3) quietness of operation and 4) service life. The standards of quality and design covering the equipment and fabrication plus the installation technique required are established on this basis. The decision of the Architect in determining the acceptability of equipment items, installation technique and workmanship is final.

6. Systems provided in the Work shall in no way damage or adversely affect architectural, mechanical, electrical or structural systems, components or construction.

7. Where dimensions and loading capacities have been omitted from the Contract Documents, determine in accordance with the requirements and intent set forth in the Contract Documents.

8. Design, fabricate and erect steel structural components and fastenings shall be in accordance with the Specifications for Design, Fabrication and Erection of Structural Steel for Buildings, latest edition, by the AISC. Perform welding in accordance with the appropriate standards of the AWS.

B. Performance Requirements:

1. Materials, components, processes and workmanship for moveable systems shall comply to the current issues or revisions of the applicable legislation, references and standards.

2. Noise and Vibration:
   a. Equipment shall operate quietly and without undue vibration. Provide isolation and damping as required to eliminate mechanical rattles, gearbox and coupling chatter and motor noise.
   b. Unless otherwise specified, noise and vibration producing equipment shall not exceed the following noise criteria at any point between 3'-0" (1m) and 6'-0" (2m) above finished floor level.
      1. On Stage: NC 25
      3. Control Rooms: NC 25
   c. The noise produced in any area by any item shall not exceed the NC criteria referenced above, in any given octave band. Where the noise level of any 1/3 octave band is more than 3dB greater than the levels of both of its adjacent 1/3 octave bands, the criteria shall be taken to be 5 units lower. Where the noise is intermittent, the criteria shall be taken to be 5 units lower.
   d. Noise levels for critical areas are specified elsewhere in the Contract Documents. Provide sound proofing where required; ensure that acoustical treatment does not cause overheating or inhibit the operation of systems.
   e. The stiffness of all structures forming a part of the stage or acting surface shall provide a satisfactory natural frequency for setting scenery and acting. Configure such structures to prevent the vibration of moved elements. Unless specifically stated, the natural frequency shall be less than 12 HZ under full loading.

C. Provide systems designed to reflect safeguards and precautions related not only to normal use of the equipment under ideal operating and loading conditions but, additionally, to anticipate equipment...

100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
misuse, human error, and misjudgment. Design and intent parameters set forth herein in no way relieve this Contractor from responsibility or liability arising from the Work.

1.07 POWERED MACHINERY BASIC REQUIREMENTS

A. Work in related Performance Machinery sections shall be provided under the direction and design of the Contractor’s professional engineer, who shall be licensed pursuant to the requirements of the Contract Documents.

B. Except where exceeded by the requirements of the Contract, provide powered hoist systems conforming to ANSI E1.6-1 (2012), and mechanical power transmission apparatus meeting at a minimum the requirements of Safety Standard for Mechanical Power Transmission Apparatus ASME B15.1-2000 as currently revised and inclusive of appendices.

C. Design Loads:
   1. Apply forces resulting from dead loads, rated loads, maximum moved loads, maximum static loads, cyclic dynamic loads, wind loads, thermal loads, impact loads, and special loads in determining the adequacy of all parts of the moveable system.
   2. Power transmission parts shall be designed so that the dynamic stresses calculated for the rated load shall not exceed the endurance limits established by the manufacturer.

D. Where multiple machines are used for moving a single load provide synchronization. Provide synchronization by either mechanical methods or appropriate controls, unless specifically described in the Contract Documents.

E. Where the failure of a single Performance Machine may create a dangerous condition or a progressive failure determine whether the individual secondary braking means is required for each Performance Machine, or if a common means may be employed for the complete system. Provide such means as determined.

F. Provide a means to stop the operation and for supporting the load, in event of failure, as required by applicable legislation and the Contract Documents.

G. Safety Devices:
   1. Provide Powered Machinery, where single point failure analysis does not show compliance with the requirements stated herein, with independent secondary means to detect overspeeds and to stop and hold the load indefinitely in the event the speed exceeds the rated design speed by 115%, unless specifically described otherwise by applicable legislation or the Contract Documents, in which instance the most stringent applies.
   2. Provide Powered Machinery Systems, as a minimum, with limit switches at terminal positions of travel, with separate and separately driven or actuated overtravel position limit switches.
   3. Where moved elements are guided, or where guided counterweights are employed, limit switches may be mounted to ensure actuation by contact or proximity of the moved element. Employment of such mounting is conditional on the locations being readily accessible for inspection and testing. Configure limit switch so as to protect them from damage in the event of overtravel.
   4. Where multiple machines are employed for moving a single object, provide a means to detect and stop the operation of all associated machines in event of malfunction of one machine. Out of synchronization operations are considered a malfunction where synchronization is required for safe operation.
   5. Employ other safety devices as necessary to detect and react to excessive variation in angle, acceleration, crushing, shearing and other similar conditions for installation where these conditions are a consideration for safe system operation.

H. Overhead Hoists
   1. Except where exceeded by the requirements of the Contract, provide overhead underhung hoists meeting at a minimum the requirement of Overhead Hoists (Underhung) ASME HST-4-1999 as currently revised and inclusive of appendices.
   2. Except where exceeded by the requirements of the Contract, provide overhead electric wire rope hoists meeting at a minimum the requirements of Performance Standard for Overhead Wire Rope Hoists ASME B-30.16-1998 as currently revised and inclusive of appendices.
3. Except where exceeded by the requirements of the Contract, provide overhead electric wire rope hoists meeting at a minimum the requirements of Performance Standard for Overhead Wire Rope Hoists ASME B-30.16-1998 as currently revised and inclusive of appendices.

1.08 PERFORMANCE EQUIPMENT BASIC ELECTRICAL REQUIREMENTS

A. This section includes general requirements for the provision of electrical wiring methods and materials for the systems described in Division 11 of these documents. Supplementary requirements are specified in specific sections relative to particular systems. Work in this section requires detailed coordination with the base building portion of the projects; particularly Division 26.

B. System Description

1. Design and Performance Requirements:
   a. Provide wiring devices complete with mounting devices and other appurtenances where required. Provide wiring devices that are the product of a single manufacturer except as specifically stated otherwise
   b. Wiring and elementary diagrams for equipment are based on the product of the specified equipment manufacturer(s) and are shown for convenience to aid in estimating the extent of the work involved. Install the equipment actually provided in accordance with the equipment manufacturer's recommendations and details in approved wiring diagrams furnished by the equipment manufacturer. Provide equipment so connected to operate in a safe, proper and efficient manner. Note that not all control circuitry is necessarily shown on the drawings but shall be installed in conduit between the points and devices indicated on the diagrams.
   c. Wiring devices, components and electrical systems shall be in compliance with the standards promulgated by NEMA and listed by Underwriters Laboratory or similar certified testing agency.

2. Equipment Connections:
   a. Unless otherwise shown on the drawings or specified herein, the intent is to provide electrical connections required to protect, properly operate, and control motors, appliances, electrical devices, and equipment furnished and installed under the Division 11 sections of these Specifications or shown on the Drawings.
   b. Refer to other sections of these specifications and to the drawings of other trades, if necessary, to determine the extent of work included under this division of these specifications.
   c. Secure equipment, except portable equipment, firmly in place. Mount components rigidly, except where resilient isolation is required. Design and provide fastenings and supports adequate to support their loads with a safety factor of at least three.
   d. Clearly mark switches, jacks, outlets, cables, connectors, etc. logically and permanently during fabrication and installation.
   e. Where many cables are run in close proximity, color code by function in a logical manner. Detail coding in instruction and operation manuals as well as signage.
   f. Take necessary precautions to prevent and guard against electromagnetic, electrostatic and radio frequency interference.
   g. Provide control system wiring which is continuous from the faceplates to the racks. Employ no splices for entire cable length.
   h. Exercise care in wiring, so as to avoid damage to the cables and to the equipment. Between racks, cabinets, consoles or modules insure cables are well-supported, neatly laced and dressed. Make joints and connections with mechanical connectors approved by the Consultant.
   i. Group terminals by signal type.
   j. When cable is surface mounted and crossing through fire walls, use the equivalent Belden fire rated plenum cable to the specified cable type.
   k. Label terminal strips, punch blocks, wire and cables in a permanent and logical manner with a unique number on each end of cable runs.
   l. Terminate all connections with rack with mating connectors, punch blocks, or terminal strips.
m. Final location of equipment is as shown on the Drawings, located in the field by the Architect or as shown on supplementary drawings prepared by the Consultant.

1.09 IDENTIFICATION SYSTEMS

A. Design Requirements
1. Provide identification not related to the work area conforming to the Americans With Disabilities Act (ADA).
2. Based on a risk analysis performed by the Contractor’s designated qualified analyst, provide equipment and systems with appropriate markings, warnings and instructions consistent with the manufacturer’s and Contractor’s duty to warn.
   a. Where required and as otherwise feasible, provide pictorial signs in addition to text. Pictographs shall always be accompanied with appropriate explanatory text. Pictorial symbols shall conform with international standards and the ADA.
   b. Design signage to account for unfavorable viewing conditions.
   c. Where wire rope is employed, locate at operating locations and at entry to maintenance points.

   Wire Rope Technical Board Form Number 193 warning signs.
4. Mounting Location and Height:
   a. Mount signage as required to provide effective direction and instruction.
   b. Mount signage with center of the sign no higher than 60" (1500mm) above the finished floor, unless specifically required. Mounting location shall be so that a person may approach within 3" of the sign without encountering protruding objects or standing within the swing path of a door.
   c. Mount hazard communication signage as to be plainly visible from a distance not less that 5'-0" (1500mm).

B. Equipment Identification
1. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view in occupied spaces or on the exterior.
2. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface that is not conspicuous.
3. Equipment Nameplates: Provide a permanent nameplate on each item of power-operated equipment. Locate on an easily accessible surface which is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
   a. Name of product and manufacturer.
   b. Model and serial number.
   c. Capacity.
   d. Ratings.
4. Designate items fabricated by the system Manufacturer with the Manufacturer's name, model number and serial number on the chassis or a name plate securely attached to the item.

C. Electrical Component Identification:
1. Wiring devices, components and electrical systems shall be labeled and/or identified in compliance with the standards promulgated by NEMA and listed by Underwriters Laboratory or similar certified testing agency.

PART 2 PRODUCTS

2.01 GENERAL

A. Commodities provided by the Contractor and the manners of installation shall comply with standards required pursuant to the provisions of the Federal Occupational Safety and Health Act, as amended.
B. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, unused at the time of installation.

C. Provide products complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.

D. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

E. Product Selection Procedures: Product selection is governed by the Contract Documents and governing regulations, not by previous project experience. Procedures governing product selection include the following:
   1. Where products or manufacturers are specified by name, accompanied by the term "or equal," or "or approved equal" comply with the Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
   2. Compliance with Standards, Codes and Regulations: Where the Specifications only require compliance with an imposed code, standard or regulation, select a product that complies with the most current and stringent standards, codes or regulations applicable.

F. Where no product available within the specified category matches satisfactorily and also complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category, or for noncompliance with specified requirements.

G. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Architect will select the color, pattern and texture from the product line selected.

H. Visual Matching: Where Specifications require matching an established Sample, the Architect's decision will be final on whether a proposed product matches satisfactorily.

**2.02 MATERIALS**

A. Employ materials that are free of defects impairing strength, durability or appearance and of best commercial quality for the purpose specified. Employ materials with structural proportions to safely sustain and withstand stresses and strains to which they will be subjected. Fabricate true to detail, clean, straight with sharply defined profiles and, unless otherwise noted, with smooth finished surfaces.

B. Material Specifications:
   1. Do not employ brittle materials or materials with unknown or unproven structural behavior in critical system components.
   2. Steel items incorporated in the Work shall be produced or made in whole or substantial part in the United States, its territories or possessions.
   5. Steel pipe: A-53 Grade B (schedule as specified herein).
   8. SSPC Steel Structures Painting Manual.

C. Allowable Stresses:
   1. The following describes allowable stressed for normal design loads:
      a. In employing structural steel members and elements, do not exceed the stress values established in the Manual of Steel Construction, latest edition, as published by the AISC.
      c. In employing structural elements made of miscellaneous metals, plastics and composite materials, do not exceed the stress values established by the manufacturer's engineers for these specific materials, based on codes, standards and proven design practices for these materials.
2. Determine allowable stresses for normal design loads combined with special design loads as follows:
   a. Allowable stresses shall not exceed the values, which would cause permanent distortion of structural or machinery components. Under certain circumstances as determined by the engineer, limited plastic distortion of moved object or moved support is permissible, provided that such distortion is intentionally designed to relieve the stresses without creating a dangerous condition.

2.03 MINIMUM STANDARDS OF SAFETY:
   A. Minimum factor of safety for lifted loads: 10.
   B. Increase the factor of safety for ropes where normal operating loads include cyclic dynamic loads, as determined by the Contractor's engineer, to suit the system operational requirements for required service life.
   C. Minimum factor of safety for static loads: 8.
   D. The factor of safety may be lowered, at the discretion and responsibility of the Contractor's engineer, if the static design loads are higher than the maximum lifted load.
   E. Threaded Fasteners: ASTM Fastener Specifications as applicable to loading. Structural fasteners shall be traceable to materials, dimensions, processing and testing.
   F. Cable and Cable Connections
      1. Unless exceeded by other regulation or standard, select, inspect and employ wire rope, wire rope pulley, drums and connections in accordance with the current edition of the Wire Rope Users Manual published by the Wire Rope Technical Board.
      2. Bending ratio: As identified by the Wire Rope Users Manual, no more than one reverse bend in six wire rope lays shall be permitted.
      3. Connections shall be capable of developing at least 80 percent of the rated breaking strength of the wire rope. Compression sleeves shall comply with MS-51844
      4. Each suspension rope shall have a "Design Factor" of at least 10. The "Design Factor" is the ratio of the rated strength of the suspension wire rope to the rated working load, and shall be calculated using the following formula: \( F = \frac{S(N)}{W} \). Where: \( F \) = Design factor, \( S \) = Manufacturer's rated strength of one suspension rope, \( N \) = Number of suspension ropes under load and \( W \) = Rated working load on all ropes at any point of travel.
      5. Manufacturers of wire rope, also identified as aircraft cable, employed in overhead lifting or suspension are required to be QPL certified pursuant to QPL-83420 as current. Provide preformed, galvanized unlubricated wire rope conforming to RRW-410 of the Type and Class commensurate with the diameter and construction determined appropriate by the Contractor's engineer. Where the Contractor determines to substitute a non-QPL Certified manufacturer, the Contractor, at no additional cost to the Project, shall provide testing of each spool employed in accordance with ASTM A 931 as current. Certificates of conformance are not substitutions for certificates of testing.
      6. Maximum Fleet Angle Typical: 1.5 Degrees.
   G. Supplementary Parts: Provide as necessary to complete each item of work, even in the event that such supplementary parts are not specifically mentioned in the Contract Documents.

2.04 PERFORMANCE POWERED MACHINERY COMPONENTS
   A. Performance Powered Machines:
      1. Prime Mover:
         a. Provide performance machines with power sufficient to raise and lower 125% of the rated load. No performance machine shall be capable of exerting power sufficient to exceed three quarters of the ultimate strength of the lowest system component as installed, or one third of the ultimate strength of the support ropes.
         b. Protect electric motors used as the prime mover for a machine with a current overload device or a circuit protected by a current overload device located on the hoist. Provide each motor with the manufacturer’s nameplate listing pertinent characteristics.
B. Performance Powered Machine Bases:
   1. Provide separate load carrying paths and redundancies where possible.
   2. Provide bases of steel or aluminum as appropriate.
   3. Machine finish mechanical drive train component mounting surfaces for accurate component
equipment alignment.
   4. Provide, as part of the base, the ability to retain loaded elements such as hoist drums in the event of
drive shaft, connection, or bearing failures.
   5. Provide drum hoist bases in compliance with ASME B30.7 as current.

C. Motors:
   1. Provide motors as specified in the Contract Documents. Provide motors of construction appropriate
   for the applied environment.
   2. Provide electric motors complying with latest standards of the National Electric Manufacturers
   Association, the Institute of Electrical and Electronic Engineers and as herein specified.
      a. Unless otherwise specified, provide motors designed for single or three (3) phase, 60Hz
      alternating current operation. Prior to ordering motors ascertain the actual voltages and other
      current characteristics that will be available and permissible for each motor. Report the same
      in writing to the Architect and obtain approval before ordering motors. The designation of
      current characteristics in these Specifications does not relieve the responsibility for
      ascertaining the actual conditions of electric service available for each motor or the proper
      operation of all motors under actual conditions.
      b. Provide class B insulation for motors 1/2HP and larger. Provide motors rated for continuous
      duty and designed for temperature rises not to exceed 55o C. for fully enclosed type, and 40o
      C. for all other types. Provide motors capable of withstanding momentary overloads of 50%
      without injurious heating. Provide motors that operate without excessive heating, flashing or
      sparking under any conditions within the specified capacity of load and speed. Motors shall
      operate quietly. Motors which are in the air-stream of the air handling units shall be the
totally enclosed type.
      c. Permanently identify motor leads and supply with connectors.
      d. Provide overload detection devices designed to protect the motor from damage.
      e. Provide starting overload protection device.
      f. Provide phase reversal protection and phase failure protection during starting.
      g. Provide undervoltage protection.
   3. Provide motors of adequate capacity to provide the proper acceleration characteristics and ensure
   movement of the maximum loads at all points of travel.
   4. The stalling load of motors shall not exceed three times the maximum lifted load.
   5. Select motors to comply with the system operational duty cycle.
   6. Provide motors of the proper type for the duty and of sufficient torque to start and run the
   equipment to which they are connected. Starting currents and running currents shall not exceed the
   limits imposed by laws, rules or regulations of the public authorities have jurisdiction or of the
   electrical utility company. Provide motors of sufficient horsepower, capacity and rated duty to
   operate the apparatus to which they are connected at the requirements set forth herein.
   7. Motors, within a system, shall all be of the same manufacturer.

D. Individual Motor Starters:
   1. For variable speed motor control, provide starters to permit ramped, variable speed, and reverse
   control of connected motors.
   2. For single speed motor control, provide starters to permit forward and reverse control of the connect
   motors, at a single speed.
   3. Provide starters with necessary attributes to permit communication with the Local Logic Control
   System, or mechanical logic devices.
   4. For motors 1/3 HP or smaller provide manual starters, with thermal locking overload protection and
   pilot light, except where interlocking or automatic control is required, provide starters with a 120
   volt combination circuit breaker and magnetic starter with pilot light.
5. For motors 1/2 HP and over, provide combination circuit breaker and magnetic across-the-line starters. Provide magnetic starters with three (3) thermal overcurrent units. Provide transformers for 120 volt control circuits with fused secondary.

6. Provide motors 1/2 HP or larger with ball or roller bearings with pressure grease lubrication.

7. Enclosures shall be NEMA Type I sheet steel with hinged cover, unless otherwise indicated.

8. Starters, within a system, shall all be of the same manufacturer.

E. Brakes:

1. Provide performance machines with at least two independent brakes complying with the following:
   a. Primary Brake:
      1. Provide a primary brake that automatically engages whenever power to its prime mover is interrupted.
      2. Provide the primary brake rated to stop and hold not less than 125% of the rated load of the machine but in no case less than the maximum lifting capacity.
      3. The primary brake shall be directly connected to the drive train of the hoisting machine, and shall not be connected through belts, chains, clutches, shear pins, roller chains or set screw type devices. The brake shall automatically set when power to the prime mover is interrupted.
   b. Secondary Brake:
      1. The secondary brake shall be an automatic brake that, if actuated during each stopping cycle, shall not engage before the hoist is stopped by the primary brake.
      2. Provide each machine with an automatic secondary brake that will stop and hold at least 125% of the rated load under an accelerating or overspeed condition. Configure the overspeed device to shut off power to the machinery.
      3. Where employed in a traction hoist, provide the secondary brake to act directly on the wire rope. Where employed on winding drum hoists, the secondary brake shall act either on the suspension wire rope or on the drum or drum shaft. Failure of the motor drive train shall not prevent operation of the secondary brake. The actuating mechanism of the secondary brake may be separate from the brake.
      4. The secondary brake shall not be used to stop the hoist except under overspeed or abnormal conditions. It shall not be bypassed or prevented from operating by any other device during overspeed conditions.
      5. The design of the secondary braking systems shall be such that the triggering mechanism is enclosed. Configure the system so parts are readily accessible for inspection and cleaning. Appropriately protect brakes from adverse environmental conditions.
   c. Overload Protection: Provide overload protection in the system to protect against equipment raising the load in excess of the capacity of the hoist braking system.
   d. Braking Loads: Account for dynamic loads induced by activation of primary and secondary braking systems in the design and installation of the system.
   e. Braking actuation results: Actuation of the secondary brake shall not:
      1. damage the suspension rope or system;
      2. impose an overturning moment in excess of 75% of the system’s stability;
      3. impose stresses in structural members in excess of 75% of their yield strength.

F. Gearing:

1. Provide gearing in accordance with applicable legislation, the Contract Documents and the applicable standards of the AGMA.
2. The Contractor's engineer is responsible for determining the service factor classification, unless specifically required in the Contract Documents or applicable legislation. Base classification on system operational cyclic requirements, type of drive machine, starting, and stopping characteristics.
4. Suitably mount gears on bearings or drums to assure proper alignment and operation.
5. Arrange and house gears so as to provide adequate lubrication.
6. Provide gear boxes with a visual oil level indicator or means of determining that the proper amount of lubricant is contained in the gearbox.
7. Provide removable inspection plates or plugs of sufficient number and size to permit visual inspection of the operating gear faces.
8. Stamp the following data on a non-corrosive plate and attach to gearboxes:
   a. Mechanical horse-power rating.
   b. Input speed.
   c. Output speed.
   d. Gear ratio.
   e. Service factor.
   f. Thermal horse-power rating.
   g. Type of lubricant.
   h. Quantity of lubricant and lubrication requirements.

G. Speed Reducers:
   1. Provide positive type speed reducers. Friction type speed reducers are not acceptable.
   2. Directly connect the speed reducer to the drum or elevating mechanism of the performance machine. The use of chains, belts, clutches, shear pins or friction-type devices are not acceptable except as required for the operation of proscenium fire safety curtains.

H. Shafting:
   2. Provide fillets at point of change in shaft diameters to prevent excessive stress concentrations in the shaft. Employ fitted keys or splines in connections subject to torques caused by moved loads.
   4. Provide splines which safely transmit the applied torques and comply with ANSI B92.1A, Involute Splines and Inspection, Inch Version or ANSI B92.2M Involute Splines, Metric Module, current editions.
   5. When line shafts are used to interconnect several independent machines or several independently mounted drums or gear reducer combinations, employ a universal joint shaft between components to compensate for shaft parallel and angular misalignments caused by installation, support structure tolerances or deflections. Flexible couplings may be employed in lieu of universal joints, provided they comply with the requirements of the Contract Documents and are designed to operate under the possible range of shaft misalignments.

I. Couplings:
   1. Provide couplings which safely transmit the applied torques in compliance with the appropriate standards.
   2. Provide flexible couplings where required for shaft alignment purposes.
   3. Only employ couplings made of steel and with steel contact surfaces for elements subject to the torques imposed by moved elements and drive motors. Elastomer or elastomer insert couplings may be used for other purposes.

J. Bearings and Mounted Units:
   1. Support shafts by anti-friction bearings or journal bearings. Provide self aligning bearings or bearing housings where possible.
   2. Provide bearing types and sizes selected to comply with operational and design life requirements. Provide adequate provisions for lubrication.
   3. Provide bearing mounting interface to maintain proper bearing alignment for replacement bearing installation.
   4. Do not employ pillow blocks with cast iron housings for drum support bearings.

K. Drums:
The Contractor’s engineer is responsible for determining the drum surface and stacking configurations. Determination of drum type shall be based on the specific application and the criteria established in the Wire Rope Technical Board’s Wire Rope Users Manual and as follows:

a. Provide winding drums with a positive means of attaching the wire rope to the drum. The drum portion of the attachment shall be capable of developing at least 4 times the rated capacity of the hoist. The wire rope portion of the attachment shall develop at least 80% of the wire rope breaking strength.

b. Configure drums so that a minimum of three complete turns of rope remain on the drum at all times.

c. Provide a means to prevent the rope from moving off the drum ends or causing a loose wrap on the drum. Provide a loose wrap detector which, when actuated, will shut off power to the hoist, actuate the primary brake and annunciate it’s activation. Provide a means to maintain tension in the wire rope during re-rigging.

d. Provide hoist drums with a pitch diameter at least 18 times the diameter of the suspension rope.

2.05 PERFORMANCE MANUAL AND POWERED MACHINERY COMPONENTS

A. Clips, Wire Rope: Size "U"-bolt wire rope clips (Crosby Clips) appropriately for the cable construction, diameter and lay of the cable with which they are employed.
   1. Saddle material: Drop forged steel
   2. "U" bolt and nut material: Steel
   3. Finish: Hot dip galvanized
   4. Federal Specification: FF-C-450 Type 1 Class 1

B. Compression Sleeves: Size compression sleeves appropriately for the cable construction and diameter of the cable with which they are employed.
   1. Material: Copper
   2. Cable connection sleeves: Oval pattern
   3. Cable stop sleeves: Cylindrical pattern
   4. Military Specification MIL-51844

C. Eyebolts: Size eyebolts for the intended application. Employ dropped forged steel shoulder pattern eyebolts.

D. Shackles: Size shackles appropriately for the intended application. Execute chain connections with chain shackles; other connections may employ anchor shackles.
   1. Shackle Material: Forged Steel
   2. Pin Material: Alloy Steel
   3. Treatments: Heat Treat and Temper
   4. Pin Type: Safety type bolt type pin or safety type round pin.
   5. Federal Specification: RR-C-271D Type IV or IVB, Grade A or greater, Class 1.
   6. Size the screw pin to ensure that the threads are not included in the bearing surface of the bolt.

E. Thimbles, Wire Rope: Size wire rope thimbles appropriately for the cable construction and diameter of the cable with which they are employed.
   2. Finishing: Free of characteristics detrimental to the rope or adjacent elements.

F. Thimbles, Manila/Fibrous and Synthetic Rope: Size appropriately for the rope construction and diameter of the rope with which they are employed.
   2. Finishing: Free of characteristics detrimental to the rope or adjacent elements.

G. Turnbuckles: Size turnbuckles appropriately for the cable construction and diameter of the cable with which they are employed.
   1. Material: Drop forged carbon steel
   2. Finish: Galvanized
3. Type: Employ Jaw - jaw type unless otherwise noted.
4. Pins: Round pins and cotter keys.

H. Guide Systems:
1. Provide guide systems, as required, for guiding, stabilizing, stopping and holding the moved elements. Where guide systems are employed, provide continuous guiding throughout the entire length of travel.
2. Provide guide rails and shoes, including their supports, to support applied forces, including stabilizing forces, and braking forces if stabilizing, braking and holding functions as performed by the guide system.
3. Provide guide systems so as not to cause accidental jamming or binding.

I. Blocks:
1. Provide blocks with the appropriate sheave for the intended cable and rope.
2. Configure blocks to prevent the hoisting rope from leaving the sheave groove. Provide block design to prevent the hoisting rope to leave the housing in event of sheave shaft failure. Configure blocks to support sheave in event of sheave shaft failure. Provide blocks ensuring sheaves are centered in the housing and run plumb without rubbing or interference with the block housing. Distance between outer face of sheave and inner face of cheek plate shall be less than one cable diameter.
3. Center Pins: Unless otherwise specified, provide sheave center pins designed to transmit the sheave load to the block housing without rotating.
4. Provide side plates (cheeks) of materials and dimensions required for the anticipated load. Provide side plates enclosing the sheave sides. Secure side plates to each other with spacer assemblies to ensure parallel alignment. Arrange spacer assemblies in a configuration to permit anticipated movement of rigging while restraining running lines from escaping sheave grooves. Provide spacers with appropriate tapers and finishes to prevent damage to running lines. Arrange spacer assemblies to provide redundant support for the running lines and sheaves in the event of sheave center pin failure. Arrange side plates to result in a rigid parallel housing for the sheave. Align each sheave within the block so that the center and sides of the groove rotate in the same axis perpendicular to the axle and parallel to the side plates.
5. Provide block assembly with attachment systems designed and fabricated to transmit the block load to the mounting structure, while permitting adjustment, alignment and maintenance of the block. Unless specifically approved by the Architect, welded connections or connections employing cut side plates with draw bolts are not acceptable.
6. Configure the block so the cable is supported according to wire rope manufacturer’s recommendations.
7. Provide blocks to be suitable for anticipated loading and required mounting.

J. Sheaves:
1. Provide sheaves designed and fabricated in to meet or exceed the current edition of ANSI A10.5 American National Standard Safety Requirements for Material Hoists, Section 14.5 and the Wire Rope Technical Board’s Wire Rope User’s Manual, except where exceeded herein.
2. Configure the depth of flare of the groove so that the hoisting rope does not rub against the flange of the sheave when entering and leaving the groove.
3. Provide bearings designed to operate under the anticipated loading conditions for the lifespan of the system. Bore the hub within the close tolerances established by manufacturers engineering data for proper press fit without need of further cup clamping devices. Boring tolerances of sheaves selected at random are subject to inspection. Provide bearings rated for the load and speed derived from the calculated batten load.
4. Properly lubricate bearings according to manufacturers' recommendation.
5. Machine grooves to be smooth and free of irregularities, tool marks and imperfections. Machine hubs to assure proper bearing alignment.
6. Metal Sheaves: Provide from machined cast blanks.
7. Synthetic Sheaves: Provide from either machined extrusion or injection molded shapes. Where applicable, machine sheave grooves and hubs according to wire rope manufacturers' recommendations.

8. The minimum sheave tread diameter for wire rope head blocks is the rope diameter x 48.

9. Provide Multiple grooved blocks, including head blocks, with grooves of equal pitch diameter. Where purchase lines are employed, provide the purchase line groove at the center of the block.

10. Finish metal sheaves as required to prevent rust without wear on wire rope.

11. Acceptable Loft Block Materials (Wire Rope)
   a. Injection molded molybdenum disulphide filled nylon
   b. Machine grooved steel

12. Acceptable Loft Block Materials (Natural or Synthetic Fiber)
   a. Injection molded molybdenum disulphide filled nylon
   b. Machine grooved steel
   c. ASTM A48 Class 40 Grey Iron w/ Machined Grooves

13. Acceptable Head Block Materials
   a. Injection molded molybdenum disulphide filled nylon
   b. Machine grooved steel
   c. ASTM A48 Class 40 Grey Iron w/ Machined Grooves

14. Acceptable Floor Block Materials
   a. ASTM A48 Class 40 Grey Iron w/ Machined Grooves

K. Guards:
   2. Provide guards which do not interfere with the operation or of the machinery and which do not restrict proper ventilation. Configure guards to avoid generation or transmission of audible noise.

L. Control of hazardous energy (lockout/tagout).
   1. Provide systems and components to permit the control of hazardous energy during servicing and maintenance of machines and equipment in which the unexpected energization or start up of the machines or equipment, or release of stored energy could cause injury to employees in accordance with 29 CFR 1910.147 The control of hazardous energy (lockout/tagout). This requirement applies, but is not limited to potential energy stored in counterweights.

M. Lubrication Provisions:
   1. Provide each component with adequate means of lubrication to ensure moving parts are lubricated. Self-sealed, self-lubricating, or dry bearings of a suitable design are acceptable. Provide oil lubricated gearboxes with a means of determining that the proper quantity of lubricant is contained in the gearbox.
   2. Provide for proper lubrication of the system components. Self sealed, self lubricating and dry bearings of suitable design may be used at the discretion of the Contractor's engineer, unless specifically required otherwise.

2.06 FABRICATION

A. Shop Assembly:
   1. Workmanship: Work shall be performed by an experienced fabricator or manufacturer and installed by experienced tradesmen. Materials, methods of fabrication, fitting, assembly, bracing, supporting, fastening, operating devices and erection shall be in accordance with the Contract Documents, reviewed shop drawings and best practices of the industry, using new and clean materials specified, having structural properties sufficient to safely sustain or withstand stresses and strains to which materials and assembled work will be subjected. Assemble, fabricate and erect all work in a neat and accurate fashion.
2. Employ materials that are free of defects impairing strength, durability or appearance and of best commercial quality for the purpose specified. Employ materials with structural proportions to safely sustain and withstand stresses and strains to which they will be subjected. Fabricate true to detail, clean, straight with sharply defined profiles and, unless otherwise noted, with smooth finished surfaces.

3. Built-In Work: Provide anchor bolts, inserts, plates, other anchorage devices and other items specified herein to be built into concrete, masonry or work of other trades, with necessary templates and instructions. Provide such devices in ample time to facilitate proper placing and installation.

4. Supplementary Parts: Provide as necessary to complete each item of work, even in the event that such supplementary parts are not specifically mentioned in the Contract Documents.

5. Coordination: Accurately cut, fit, drill and tap Work herein to accommodate and fit work of other trades. Provide or obtain templates and drawings to or from applicable trades for proper coordination of this Work.

6. Connections:
   a. Make connections with tight joints, capable of developing full strength of the members and flush unless indicated otherwise. Locate joints where least conspicuous. Unless indicated otherwise, weld or bolt shop connections; bolt or screw field connections. Provide control joints as required to accommodate environmental variations.
   b. Employ fastening systems of appropriate sizes, ratings and quantities for the application. Where rated fasteners are employed, Provide domestically manufactured fasteners rated for anticipated loads and with approved markings indicating their rating. Provide fastener system's components of the same manufacture and equal ratings.
   c. Holes: Drill or cleanly punch holes, do not burn.
   d. Clean and leave unpainted the contact surfaces of bolted and welded connections. Fabricate built-ups and joints from components that are straight and close fitting, free from twists, bends or open joints in the finished assembly.
   e. Provide and assume responsibility for the location and maintenance in proper position of sleeves, inserts and anchor bolts required for the work. In the event that failure to do so requires cutting and patching of finished work, perform the work without additional cost to the Owner.
   f. Bolted connections: Drive bolts accurately into the holes without damaging the thread. Set bolt heads and nuts to rest squarely against metal. Protect bolt heads from damage during driving. Where members having sloping flange faces, provide bolted connections with appropriate beveled washers to afford square seating of heads and nuts. Do not locate holes in steel members less than 5 bolt diameters from an edge.
   g. Tighten fasteners to the torque specified by the AISC, SAE or applicable standard.
   h. Size bolts to extend not less than 1/4" (6mm) beyond the nuts. Do not employ fasteners that may interfere with the operation or safety of the Work.
   i. Employ high strength steel bolts in friction only.
   j. In addition to all other requirements, install a hardened washer between bolt heads, nuts and materials having elongated holes.
   k. Unless specifically noted, and excepting graded, rated or otherwise certified fasteners, use nylon locking type nuts in locations subject to vibration and loosening.
   l. Unless otherwise noted, exposed bolt and screw heads shall be flat and countersunk.

7. Welded Connections:
   a. Prior to welding pay particular attention to surface preparation, fit up and cleanliness of surfaces being welded.
   b. Follow the American Welding Society Standard for Welding.
   c. Perform welding in accordance with the American Welding Society's approved methods.

8. Insofar as practicable, perform fitting and assembly of the Work in the shop. Shop assemble the Work in the largest practical sizes to minimize field work. It is the responsibility of this Contractor to assure himself that shop fabricated items properly fit the field condition. In the event that shop fabricated items do not fit the field condition, return the item to the shop for correction.

9. Cutting:
a. Cut metal by sawing, shearing or blanking. Flame cutting is permitted only when edges are ground back to clean, smooth edges and no deformation or damage is caused to the metal by the process. Make cuts accurate, clean, sharp and free of burrs, without deforming adjacent surfaces or metals.

10. Where dimensions and characteristics have been omitted, furnish based on criteria set forth herein.

B. Shop / Factory Finishing:

1. Environmental Standards: Finish materials shall comply with the following:
   a. Environmental Protection Agency (EPA) requirements for less than 350 grams per liter of Volatile Organic Compounds (VOC) for finishes applied to components.

2. General:
   a. Clean and shop paint, with one coat of primer, all ferrous metals. No shop primer paint is required on galvanized materials, copper, brass, bronze or aluminum materials.
   b. Protective Coatings: Whenever dissimilar metals are in contact and aluminum metals are in contact with or imbedded in concrete, cement, mortar, plaster or masonry, separate contact surfaces by coating each contact surface, prior to assembly or installation with one coat of protective coating in addition to the shop paint prime coat described herein. Mask off those surfaces not required to receive protective coatings.

3. Preparation:
   a. Clean steel in accordance with SSPC-SP2 Hand Tool Cleaning.
   b. Protect sheave grooves, bolt threads, and moving parts prior to painting.

4. After fabrication, all steel; apply a shop coat of paint except the following:
   a. Areas within 2" of field welds.
   b. Contact surfaces of high strength bolted friction connections.
   c. Milled surfaces.
   d. Sheave Grooves.

5. Application:
   a. Apply shop prime coat immediately after cleaning metal. Apply paint in dry weather or under cover. Metal surfaces shall be free from frost or moisture when painted. Paint all metal surfaces including edges, joints, holes and corners. Prior to assembly, paint surfaces that will be concealed after such assembly. Apply paint in accordance with approved paint manufacturer's printed instructions and use thinners, adulterants or admixtures only as stated in said instructions. Paint materials uniformly to completely cover the metal surfaces.
   b. Apply paint to dry surfaces, when temperatures are above dew point, thoroughly and evenly, strict accordance with manufacturer's, to provide dry film thickness of 0.5 mils. Allow paint to dry before handling or loading steel for shipment.
   c. Apply a second coat of shop paint to surfaces inaccessible after assembly or erection.
   d. Protect machined surfaces by an accepted, neutral, rust inhibitive coating of a type not requiring removal and resistant to wear.
   e. Include painting details in the shop drawings.
   f. Sequence finishing of materials requiring anodized finishes to ensure that finished surface is not damaged during fabrication.

6. Field Touch-Up:
   a. After erection, clean all damaged areas in the shop coat, loosened scale, rust, exposed surfaces of bolts, nuts, and washers, all field welds and unpainted areas (except as mentioned) to the same standard as the shop coat and paint with the same paint used for the shop coat, at the same film thickness.
   b. Shop prime ferrous metals with fast-curing, lead and chromate free universal modified-alkyd primer complying with the performance requirements of FS TT-P-664, selected for good resistance to normal atmospheric corrosion, compatibility with finish systems indicated and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
   c. Do not paint moving parts acting as bearing surfaces or subject to friction wear.

C. Factory Finishing Colors:
1. Finish ferrous metals visible from the audience chamber in flat black.
2. Finish grid or floor mounted blocks, loft blocks and headblocks yellow in accordance with OSHA 29 CFR 1910.144 and ANSI Z535.1
3. Do not paint sheave grooves, fasteners, aluminum or galvanized materials and products.
4. Treat timber products with clear penetrating stain.

2.07 SIGNAGE:
A. Provide signage in English.
B. Employ printed or stenciled characters. Handwritten characters are not acceptable.
C. Wall mount diagrams depicting the system layout and maximum load limitations (drawn not less than 1/4"=1'-0" – 1:50) in a protective transparent faced frame on the stage wall near the locking rail and near the loading gallery entrance as to be plainly visible, and as not to interfere with the operation of the system.
D. Clearly display the rated load capacity on each moved element together with restrictions for maximum load concentrations and load locations on the moved element and associated control.
E. The stroke “width-to-height” ratio shall be between 1:6 -1:8. Separate lines of by leading that is approximately 120% of the type point size. Unless specified by regulation or standard, calculate text height in inches based on unfavorable viewing conditions based on the viewing distance in feet multiplied by 0.084 (in mm based on meters x .0045).
F. Numbers and Labels: Employ UL listed, indelible adhesive backed coated polyester printed labels with adhesives designed for the surface energy of the mounting surface.
G. Manual and Powered Linesets
   1. Number each arbor with characters located on the back bar of the arbor 6" below the arbor top. Locate double digit numbers with one digit on either side of the tie rod, as to be clearly visible. Apply white characters on dark backgrounds Minimum height viewing distance: 5'-0" (1500mm).
   2. Clearly mark each lineset number on the index strip of each lockrail at the appropriate spacing with black letters on a white background. Minimum viewing distance: 4'-0" (1200mm).
   3. Mark the onstage side of each arbor tie bar at spreader plate locations with labels notifying the operator that a spreader plates are to be inserted at that position.
   4. Paint the exposed faces of counterweights constituting pipe weight for each lineset with Safety Yellow enamel as defined by ANSI Z535.1. For those pipes with connector strips, pipe weight is to include the weight for those strips and associated hardware.
   5. In locations agreed to by the Architect, provide signage at lock rail and loading gallery identifying the size and weight of each size and type of counterweight provided.
   6. Number each batten, identically to its location on the index strip, on both ends as to be read from above and below with white characters on a dark background. Minimum viewing distance: 20'-0" (6000mm).
   7. Except for linesets dedicated to potentially visually-sensitive locations, such as an orchestra shell, mark battens with a painted white stripe 1" wide running around the full circumference at the centerline of the proscenium in white and at 1'-0" (300mm) increments from the left and right of the centerline in white. Indicate the distance from the midpoint in 5'-0"(1500mm) increments. Mid line and ends excepted, increments may be marked with white indelible marker. Paint the end of each pipe and each extension with safety orange stripes 1'-0" (300mm) from the ends toward the midpoint. Mark the section of batten extension to remain in the batten with safety red stripes.
   8. Number blocks as follows with white adhesive 36pt. sans serif numerals:
      a. Head Blocks: Consecutive set numbers on each side plate 1" (25mm) from on-stage edges.
      b. Loft Blocks: Consecutive set numbers on the up-stage side plate followed by a stroke and the line number as counted from the arbor.
      c. Mule Blocks: Consecutive set numbers on the bottom side plate followed by a stroke and the line number as counted from the arbor.
   9. Number each hoist with characters viewable from the adjacent walking surface. Apply white characters on dark backgrounds Minimum height viewing distance: 5'-0" (1500mm).
10. In locations agreed to by the Architect, provide signage at control locations, loading gallery, grid iron identifying all pertinent hazards, avoidance procedures and consequences. In addition to safety requirement, list on the signage the standard size of system load capacities provided and their respective weights.

H. In locations agreed to by the Architect, provide signage identifying all pertinent hazards, avoidance procedures and consequences.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:
   1. Examine work prepared by others to receive work of this Section and report defects affecting installation to the Purchaser for correction. Commencement of the work shall be construed as complete acceptance of preparatory work by others. The sphere of inspection includes but is not limited to:
      a. Assurance mounting surfaces are ready to accept the Work.
      b. Verification of flatness, plumb and level of mounting conditions.
      c. Inspection of components of the Work to ensure no damage has occurred during shipping or storage.
   2. Coordinate staging, sequencing and access.
   3. Discrepancies:
      a. In the event of discrepancies, immediately notify the Architect.
      b. Do not proceed with the installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 SITE CONDITIONS

A. Sequence delivery and installation of components to protect their long term viability. Of particular concern is protecting stage and acoustical draperies from abrasive construction dust and grit and protecting drapes from the accumulation of dust which can lead to an aesthetic finish concern, premature wear, and a combustion hazard due to fine dust particles.

B. Do not deliver stage or acoustic drapery to the site where the ambient relative humidity is greater than 65% for more than a 12-hour period.

C. If stage or acoustical drapery must be installed prior to room being clean, dry, and dust free, completely wrap and protect drapery from the infiltration of dust and thoroughly clean drapery prior to final testing. Drapery that shows wear or construction dust residue will be rejected.

3.03 PREPARATION

A. Verify field measurements at the site prior to installation and modify the system accordingly.
   1. Deliver equipment to the site only after the building has been closed in. Coordinate storage at the site and ensure the materials and components are undamaged.
   2. Do not install work until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above is complete, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.
   3. Equipment and components that show wear or rusting due to excessive moisture will be rejected.
   4. Protect the surrounding environment from damage by the Work.

B. Surface Preparation:
   1. Clean surfaces as necessary prior to commencing the Work.

C. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner. Commencement of the work shall be construed as complete acceptance of preparatory work by others.

100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
D. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.

E. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.


H. Recheck measurements and dimensions, before starting each installation.

I. Install each component during environmental conditions and Project status that will ensure the best possible results.

J. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.

K. Built-In Work: Provide anchor bolts, inserts, plates and any other anchorage devices and all other items specified herein to be built into concrete, masonry or work of other trades, with necessary templates and instructions. Provide such devices in ample time to facilitate proper placing and installation.

L. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.

M. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Architect for final decision.

3.04 ERECTION, INSTALLATION AND APPLICATION:

A. Workmanship:
   1. Workmanship shall be best quality; executed by workers skilled and experienced in the respective duties for which they are employed. Immediately notify the Architect if required Work is such as to make it impractical to produce required results.
   2. Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with the Architect, whose decision is final.

B. Install the system with care that the components are straight, plumb, true and aligned throughout. Tightly fit connections employing appropriate safety factors and arrange in an orderly manner.

C. Perform the Work in conformance with the best trade practices, fabricate and install items in accordance with manufacturers' recommendations and Architect's direction. Coordinate Work with trades doing adjoining work.

D. Install the system complete with all members and materials, and all bolts, nuts, washers, clips, fittings, supports, or other items required for attaching all equipment specified to the existing construction.

E. Perform required cutting, drilling, tapping and fitting to properly install and secure the Work in place. Cutting or drilling existing structural work shall have the prior review of the Architect. Perform the mechanical fabrication and workmanship in accordance with neat and mechanically acceptable practices such as clean drilled and punched holes without flash, hard smooth finish for sheared, machined, and cut edges, and proper fit of component and contiguous parts without irregularity where marching is intended. Welding shall meet qualifications of AISC manual and shall be without spatter and other evidence of poor practice. Welding of load bearing elements shall be performed by certified welders. Comply with AWS Code for procedures of manual shielded metal arc welding, appearance and quality of welds made and methods used in the correction of welding work. Moving parts shall have specified tolerances, shaft sizes, bearings, mounting, connections, and accessories coordinated into the work in a manner acceptable to the Architect. Do not incorporate wood construction or equipment into the Work except as set forth in the Specifications.

F. Erection:
1. Fastening:
   a. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Such fasteners include, but are not limited to: threaded fasteners for concrete and masonry inserts, through bolts, lag bolts, wood screws and other connectors as required.
   b. Provide metal fastenings and accessories in same texture, color and finish as adjacent materials, unless indicated otherwise.
   c. Prevent electrolytic action between dissimilar metals and materials.
   d. Space anchors within their load limit and shear capacity; ensure that they provide positive and permanent anchorage. Wood and other organic material plugs are not acceptable.
   e. Keep fastenings to a minimum, space evenly and install neatly.
   f. Fastenings which cause spalling or cracking of material to which anchorage is made are unacceptable.
   g. Where turnbuckles are employed in the suspension of overhead loads provide positive safetying in accordance with MS 33591B(AS) and as to provide equivalent resistance and strength to an equivalent locking clip system as defined under MIL-DTL-8878H Turnbuckles Positive Safetying.

2. Cutting, fitting and placement: Perform cutting, drilling and fitting required for installation of fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.

G. Hoisting Rope Connections:
   1. Employ rope fastenings which develop not less than 100% of the manufacturer's rated breaking strength of the rope employed.
   2. Qualified personnel are responsible for installing fasteners.
   3. Equalization of Hoisting Rope Tension:
      a. Provide means to substantially equalize the tensions between ropes which are in close proximity to each other.
      b. Where suspension rope equalizers are employed, provide those of the individual compression spring or bar type. The latter type, provide the attachment by means of an entrapment bar to prevent separation of the equalizer bar from the lifted element. Extension spring type equalizers are not acceptable.

4. Reeve typical linesets with the specified wire rope for the lift lines and 3/4" synthetic rope for the purchase lines.
5. Employ one continuous length of cable for each lift line. The lengthening, joining or repairing of two or more sections of wire rope is prohibited. Mid-line splices are unacceptable.
6. Cut cable and compress sleeves only by use of the appropriate tool and operation for the cable and application.
7. Wire Rope Eye Splices: Form an eye on both ends of the lift line around an appropriate thimble. Close eyes with a copper compression sleeve. Crimp the sleeve with the appropriate tool per manufacturer’s instructions. After crimping, test the sleeve for compliance with manufacturers requirements. In the event that the crimped sleeve does not comply with the specifications, cut the cable above the sleeve and form a new splice.
8. Secure the end of the lift line, at the appropriate trim to the batten connection device.
9. Other types of fasteners are permitted, provided that adequate tensile and fatigue tests have been made by a qualified testing agency and that the fasteners have been approved for the intended or similar use.
10. Align loads on pins via steel spacing washers to assure even loading. After closing the shackle, deform the cotter pin at the end to prevent unintentional loosening of the pin.

H. Electrical Installation and Coordination
   1. Provide racks, furniture, consoles, etc., required for the installation and needed to provide completed systems.
   2. Furnish all low voltage cable to Division 26 contractor for installation. This includes standard and specialty cable.
3. Terminate and install low voltage faceplates.
4. Terminate control lines.
5. Terminate low voltage connections in motor control panels.
6. Interface:
   a. Coordinate work with the Division 26 Contractor in accordance with the contract documents.
   b. Contract documents are diagrammatic and indicate general arrangement of systems and work included.
   c. Follow drawings in laying out work and check drawings of other trades relating to work to verify spaces in which work is installed.
   d. Maintain headroom and space conditions at all points.

3.05 TESTING, DEMONSTRATION, AND INSTRUCTION

A. Prior to testing and certification, coordinate with the Architect the personnel required to be present during the events. Unless specifically designated by the Architect, testing, certification and operation of equipment is to be performed solely by the Contractor. Where the Architect or his designee deems it necessary to personally perform a test or operate equipment in order to determine compliance with the Contract, the Contractor shall coordinate the operation and provide the necessary approvals from authorities and organizations having jurisdiction over the Work.

B. The Contractor’s Project Manager, or a designee familiar with the engineering and installation of the system(s), will coordinate and be present at all certification and testing by the Architect and the Architect’s Consultant.

C. Clearly record the date, time, personnel, details and results of all the following tests and demonstrations and any subsequent re-tests. This will form the start of a system log book to be handed over to the user after acceptance together with operation and maintenance manuals.

D. Inspect the completely assembled hoist system including all mechanisms, fittings, control panels, etc., and make good all deficiencies before certifying that the system is complete.

E. Certify compliance with tolerances specified in the Contract Documents.

F. Certify function of braking systems.

G. Certify speed, noise and stability compliance with the Contract Documents.

H. With hoist fully loaded, perform motor current checks. Test drive unit including the effect of a loss of one or more phases, of reduced voltage and of phase reversal. Test mobile control box and all indicators. Record results of all tests.

I. Certify motion with full specified dynamic payload.

J. Provide demonstration and testing as required to obtain certification by the applicable legislative authority. This Contractor is solely responsible for obtaining such certification and all costs arising from the certification. Certification is a condition of substantial completion.

K. The completed installation of rigging equipment with draperies properly installed shall be tested and operated by the Contractor for the acceptance by the Architect by the Rigging Contractor prior to acceptance.

L. The Contractor is completely and solely responsible for any testing required by the Architect and authorities having jurisdiction to ensure compliance with the Contract Documents and applicable laws and regulations.

M. In case the need for further adjustments becomes evident during the demonstration and testing, continue the Work until the systems operate properly.

N. If more than one (1) visit is required by the Architect’s Consultant because the system does not fulfill this specification, pay for time and expenses of the Architect’s Consultant during any extensions of the acceptance testing period.

O. Demonstration and Instruction
   1. In addition to requirements in Division 1, provide the quantity of hours training indicated in the contract documents.
2. Demonstrate the full capabilities of the system(s), demonstrating how it meets specification, and demonstrates areas in which it exceeds specification.
3. Provide Training on this equipment system to be scheduled at times mutually agreed upon with the owner. This training time is to be divided into the following sessions as a minimum:
   a. Initial training
   b. Follow-up training.
4. Video record the initial and subsequent training sessions. Provide the owner with five (5) copies of a DVD of that recording, in addition to other training materials.

P. Assurances:
   1. At the time of the Architect’s final review, provide a notarized affidavit stating compliance with the criteria of the Contract Documents and applicable standards, laws and regulations. Include certification that connections, including cable connections, have been made in accordance with applicable standards and manufacturer’s recommendations. Where connection methods require specific torque, pressure, periodic tool calibration or measured dimension to ensure function, provide certification that such methods have been performed and record of activities.

3.06 PROJECT CREDIT
   A. In publications where this project is mentioned give credit to:
      1. The Design Architect
      2. Theatre Consultant: Theatre Consultants Collaborative, Inc.

END OF SECTION
1.01 SUMMARY

A. Performance manual rigging includes manually operated equipment assemblies, systems and components required for locating scenic, acoustic, lighting and masking elements in variable vertical planes.

B. Section includes provision of materials, components, modifications, assemblies, equipment and services as specified herein. These include:
   1. Provisions as required under Division 1.
   2. Verification of site dimensions and conditions.
   3. Submission of Shop Drawings signed and sealed by a licensed Professional Engineer experienced in work of similar nature and scope and licensed in the State of installation.
   4. Engineering of equipment and systems as required by the Contract Documents.
   5. Manufacture of equipment and systems as required by the Contract Documents.
   6. Scheduling, sequencing and coordination with other trades.
   7. Site supervision of equipment and systems installation specified herein and elsewhere in the Contract Documents.
   8. Testing, demonstration, and certification of equipment and systems as specified herein and elsewhere in the Contract Documents.

C. Provide systems including:
   1. Underhung single purchase counterweight sets and pipe battens.
   2. Grid mounted diverter blocks to route cables through grid wells.
   3. Hemp spotlines rigging and sandbags.
   4. Locking rails.
   5. Complete battery of counterweight guide tracks.
   6. Outriggers with index strip lights and scenery bumpers.
   7. Cable management equipment for connector strip(s), as well as any additional multicable devices.
   8. Additional support structures as required to meet the intent of the Contract Documents.
   9. Provide devices and components that are NEMA compliant and UL approved for the applications. Wiring and electrical service shall be performed by a licensed electrician and conform to applicable codes.

D. Products Installed but Not Furnished Under This Section:
   1. Draperies as furnished under Section 11 6143 Performance and Acoustical Draperies.
   2. Performance Drapery Tracks and Motors as furnished under Section 11 6144 Performance Drapery Tracks.
   3. Powered Adjustable Acoustic Devices as furnished under Section 11 6155.
   4. Rigging of connector strip(s) furnished under Section 11 6161 Performance Dimmers and Controls.
   5. Rigging of Orchestra Shell ceiling panels furnished by the Orchestra Shell contractor.
   6. Installation of Proscenium Safety Curtain System furnished under Section 11 6137.

E. Related Sections:
   1. Division 1: General and Supplementary Requirements.
   2. Division 3: Concrete.
   3. Division 4: Masonry.
   4. Division 5: Metals.
   7. Division 11: Equipment.
      a. 11 6100: Performance Machinery General Requirements.
      b. 11 6124: Orchestra Shell
c. 11 6143: Performance and Acoustic Draperies.
d. 11 6144: Performance Drapery Track
e. 11 6135: Performance Powered Rigging
f. 11 6137: Proscenium Safety Curtain.
g. 116155: Acoustic Powered Rigging

8. Division 23: Mechanical.

1.02 DEFINITIONS
A. Hemp Set: An adjustable rigging system consisting of synthetic rope, moveable, grid mounted, upright loft blocks and sandbag counterweights.

1.03 SYSTEM DESCRIPTION
A. Performance Requirements:
1. Section 11 6100 establishes minimum requirements for the system. Where Federal, State, Local Legislation and consensus standards address these topics, the more stringent requirements take precedence. The minimum standards for construction and installation shall meet or exceed the requirements of the Applicable Project Building Code (per project) and ANSI E1.4-1 (2016) except as exceeded by these specifications. Where standards requirements conflict, the construction shall conform to the following order: Federal, State, and Local Legislation; Applicable Project Building Code; ANSI E1.4-1; these specifications.
2. Factors listed below in no way relieve this Contractor from the sole responsibility of providing safe systems.
B. Provide assemblies, cable components, connections, equipment, hardware and linkages employed in supporting, in whole or in part, overhead loads that are rated and designed for that application. Base loading for each component on the maximum percentage of the capacity of the set in which the component is employed. Base the set capacity on the batten length multiplied by a thirty pound per linear foot (30 plf) load, in addition to self weight and associated impact factors.
C. Provide mule blocks, rollers and guides as required to provide proper alignment and maintain allowable fleet angles.

1.04 SUBMITTALS
A. In addition to submittals required under Division 1 and Section 11 6100, for items listed herein, provide manufacturer’s data and certification of compliance

1.05 WARRANTY
A. Special Warranty:
1. Warrant systems and equipment to be free of defective components, faulty workmanship and improper adjustment for a period of two years from the date of Final Acceptance. Paint and exterior finishes are excluded relative to failure due to unusual exposure. Replace items showing evidence of defective materials or workmanship (including installation workmanship) within thirty (30) days after notification. Make replacements without cost to the Owner. Rectify conditions that might present a hazard to human life, well-being, and or property within 48 hours of notification.
2. Designate warranties on manufactured equipment to the Owner on the date of Final Acceptance.

1.06 MAINTENANCE
A. Maintenance Service:
1. Provide maintenance service for a period of one year after final acceptance of the installation. This service consists of at least two half-yearly visits to the site for checking and adjusting of equipment.
2. Perform the first visit sixty days after the system has been accepted. Arrange visit to be at a time mutually agreeable to the Owner and Contractor.
PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide the rigging systems from components (except where otherwise stated) that are the products of one of the following manufacturers. Additional manufacturers may be used if approved in writing by the Architect, or as defined in Division 1.
   1. H&H Specialties Inc., South El Monte, CA.
   2. iWeiss, Fairview, NJ
   4. Texas Scenic Company, San Antonio, TX

B. Bearings:
   1. Dodge/Reliance Electric Corp., Cleveland, OH
   2. FAG Bearings Corp., Stamford, CT.
   3. Timken Co., Canton, Ohio.

C. Cable and chain connection hardware:
   1. Chicago Hardware and Fixture Company, Chicago, IL.
   2. Columbus McKinnon Corporation, Chain Division, Amherst, NY.
   3. Cooper Industries, Campbell Chain Division, Inc., NC.
   4. The Crosby Group, Inc., Tulsa, OK.

D. Compression sleeves:
   2. National Telephone Supply Company, Cleveland, OH.

E. Synthetic ropes:
   1. All Line Inc. Naperville, IL.
   3. Atlantic Cordage Corporation, Carteret, NJ.

F. Wire Rope: Refer to Section 11 6100, Performance Machinery Basic Requirements.

2.02 MATERIALS


B. Guide Track and Hardware
   1. Guide Tracks
      a. Provide guide tracks of steel or aluminum with brackets, fishplates and clips of compatible materials.
      b. Provide rails with a “T” section at the guide shoe connection point sized to allow adjacent guide shoes to pass each other without interference. Provide track sections with a sectional area and material properties to withstand the forces resulting from the fully loaded guided counterweight arbors.
      c. Provide tracks sufficiently true and smooth to operate properly with the guiding members.
   2. Brackets, Fastenings, Joints and Supports
      a. Provide guide track brackets, fastenings and supports capable of resisting horizontal forces imposed by anticipated loading with the total deflection at the point of support not in excess of 1/8" (3.2mm).
      b. Provide track joints so that they are equivalent to or greater strength than the track and adequately maintain the accuracy of the rail alignment.

2.03 MANUFACTURED UNITS

A. Counterweights:
1. Typical Set: "U"-slotted type. Provide weights from cut steel in thick nesses and quantities specified herein. Finish with hand smooth edges, free from burrs. Chamfer at 45° two diagonal corners of each weight to allow ease of loading. Slot weight ends to accommodate arbor tie rods.

2. Individual weights are not to exceed thirty-five (35) pounds.

B. Blocks:
1. Refer to Section 11 6100, Performance Machinery Basic Requirements for performance criteria.
2. Single Purchase Headblocks, Upright:
   a. Provide upright headblocks with sheave aligned to permit the purchase and lift lines to operate, within the tolerances specified herein, with the arbors, loftblocks, and rope locks.
   b. Provide head blocks each with a single sheave of multiple grooves as specified herein.
3. Loft blocks, Underhung:
   a. Provide blocks that allow positioning of the cable to pass through the grid well at its center line.
   b. Provide each underhung block with idler sheaves for guiding and supporting running lines at proper elevation and quantities related to the headblocks. Equip blocks with the requisite number of idlers to prevent cable from sagging, touching and wearing against other elements. Size idlers for intended rope.
   c. For the loft blocks closest to the headblocks, in lieu of idlers, provide each with a single sheave of multiple grooves of the quantity of lift lines required for the set.
   d. Refer to Section 11 6100, Performance Machinery Basic Requirements for additional performance criteria.
4. Temporary Rope Loft Blocks
   a. Provide blocks as required designed for electrical multi-cable management. Provide additional blocks of the quantity specified herein for temporary rigging points.
   b. Provide blocks that allow positioning of ¾" synthetic rope to pass through the gridiron at either a grid well or through openings in the grid floor.
   c. Refer to Section 11 6100, Performance Machinery Basic Requirements for additional performance criteria.
5. Tension Blocks:
   a. Provide with appropriately sized side plates and a kick plate located at the upper on-stage corner.
   b. Provide tension blocks of sufficient weight to maintain constant tension on purchase line.
   c. Configure the block mounting to ride freely in the guide tracks on 2 sets of guide shoes of similar arrangement as the associated counterweight arbor. Ensure that the tension block properly engages track and remains in set location while purchase line is under tension.

C. Sheaves: Refer to Section 11 6100, Performance Machinery Basic Requirements for performance criteria.

D. Counterweight Arbors:
1. Provide each set with a counterweight arbor provided at a length sufficient to contain the counterweights required for balancing the load within fifty (50) pounds the weight of the batten loaded at twenty-five pounds per linear foot (25 plf) for general purpose battens, and thirty pounds per linear foot (30plf) for stage electrics, in addition to the batten weight. Weight dimensions as specified herein. Size length to permit the loading and unloading of weights when arbor is loaded to its capacity. Provide the arbor assembly to be of sufficient strength to safely support weight on the arbor, load on cables and operating pull.
2. Support the arbor from a cable clew arrangement mounted at the arbor top with a sufficient number of shackle attachment points to accommodate the total number of cables in addition to the purchase line.
3. Secure the top and bottom of the arbor with two appropriately sized steel rods. Provide tie rods for counterweight arbor from appropriately sized rod with cut threads and double full nuts top and bottom as well as single full nuts on the inside. Provide washers between nuts and arbor tops and bottoms.
4. Space the rods to accommodate counterweights. Do not allow counterweights to rest on nuts.
5. Provide safety collars to lock the counterweights in place. Tap and fit safety collars with a thumb screw to allow adjustment on the tie rods. Secure the safety collars to the top spreader plate to permit storage during loading and to secure the weights.

6. Incorporate an attachment point to the arbor top and bottom for the connection of the purchase line.

7. Secure an additional shouldered eye lug to the on stage side of the arbor bottom for potential attachment of an additional 3/4” fiber hauling line.

8. Mount the top and bottom frames to the guide tracks via guide shoes on a vertical tie bar rigidly connecting the top and bottom of the arbor together.

9. Configure guide arrangement to maintain arbor stability throughout travel and restrain arbor from lateral movement due to impact and lateral forces.

10. Provide each arbor with adjustable diaphragms (spreader plates) to ensure tie rods remain parallel throughout their length under anticipated loading conditions and retain the counterweights. Provide diaphragms to be held captive in the horizontal planes by the tie rods. Provide plates to resist deformation of the arbor and evenly distribute the counterweights in a compact fashion. Provide quantity of plates required to retain weights in the arbor in the case of an impact event.

E. Locking Rails:

1. Provide the rail to withstand a five hundred pound per linear foot (500 plf) uplift, with a non-concurrent one thousand (1000) pound concentrated load at any location along the rail.

2. Provide locking rail(s) extending the full depth of the stage as indicated on the Drawings and as to accommodate the complete battery of counterweight guide tracks. Configure each rail with a top angle to accommodate rope locks at the appropriate corresponding position to the guide tracks and with brackets for 3” x 5” index card holders. Incorporate a tubular steel or rolled angle reaction bar on the bottom of the rail configured to engage a portable capstan winch.

3. Provide the complete length of the locking rail with a pair steel sections mounted so as to provide a positive top and bottom stop for arbor travel. Secure timber sections on the top of the steel stop sections to absorb impact. Cover the top of the timbers sections with 1/4” thick neoprene sheet. Secure neoprene with a synthetic adhesive. Mount the stop batten assembly in a manner that does not interfere with arbor travel or system operation.

4. For stage level lock rail, Incorporate a 4.5” outside diameter pinrail with the top quadrant 2” below the bottom of the index strip and the offstage quadrant coplanar with the on stage edge of the index strip. Perforate through the rail 1.25” diameter holes to accommodate belaying pins. Stagger holes to center belaying pins between rope locks.

F. Rope Locks:

1. Provide the rope lock with a 9” encapsulated steel eccentric lever and steel, ductile or malleable iron cams to provide quick action locking. When locks are fully engaged handles shall be perpendicular to the floor. Provide a thumb screw with jam-nuts for pressure adjustment. Provide locks with nylon spacers between the locking dogs, levers and casting to reduce noise.

2. Bolt the rope locks to the locking rail with appropriate fasteners.

3. Provide locks with elliptical slip rings to prevent movement of lever by tensioning against the purchase line. Encapsulate slip rings in plastic of the same color as the handle.

4. Provide a synthetic rubber bumper on lock mounting angle to prevent noise from handle impact.

5. Encapsulate identified items in red poly-vinyl chloride, 25 mls thick and testing between fifty (50) and sixty (60) on a durometer scale.

6. Provide locks designed to comply with the control of hazardous energy plan in compliance with 29 CFR 1910.147 The control of hazardous energy (lockout/tagout).

G. Pipe Battens:

1. Provide typical pipe battens of seamless black wrought steel pipe as specified above.

2. Provide splices from sleeved tubing arranged so the spliced batten equals or exceeds the strength of the continuous batten material. Secure splices using removable, appropriately rated threaded fasteners in a fashion that no part of the fastener extends beyond the batten surface by more than 1/8”. Arrange splices to ensure batten deflection in any span does not exceed the deflection of a continuous batten of equal span under the loading criteria specified herein.
3. Provide batten length depicted for each set on the Drawings. Incorporate full pipe sections for each batten with only one partial section located on center line. Drill both ends of the battens for batten splices and extensions.

4. Provide an additional batten at each electric raceway location. Locate battens both on top of and below raceway.

5. In addition to raceway locations, provide an additional batten and pipe clamps at each location noted as “Electric.” Support additional pipe from primary batten with clamps on 5'-0” spacing, maintaining 10” clear between pipes.

H. Truss Battens
   1. Provide truss battens for linesets dedicated to orchestra shell ceilings (typical of 3) and first electric. Refer to schedule on drawings.
   2. Fabricate truss battens from rolled steel sections arranged to meet the deflection and loading requirements of the Contract Documents. Provide battens with a bottom chord of 1-1/2” nominal Seamless Black Steel Pipe. Provide the top chord of a square or rectangular section no greater that 2” in width to minimize lateral deflection of the truss. Arrange webs so as to minimize interference with equipment mounting to the bottom chord. Provide truss panel connections of rated threaded fasteners and internal splice sleeves to allow field disassembly. Secure trusses to lift lines with formed cable eyes and compression sleeves, jaw-jaw turnbuckles and formed steel clamps bolted around the top and bottom truss chords with appropriately rated fasteners.

3. Provide truss length depicted for each set on the Drawings. Incorporate full pipe sections for each member with only one partial section located on center line. Drill both ends of the bottom chord for extensions.

4. Batten Extensions:
   a. Provide steel pipe extensions for the off-stage ends of each batten. Extension length is determined as the amount of pipe extended from main batten, as defined in the schedule below. Provide additional length of pipe as required to remain sleeved inside for support.
   b. Provide extensions which sleeve within the batten when not deployed. Size extensions to safely support a load of twenty pounds per linear foot (20 plf), and to have an outside diameter not less than 1 inch.
   c. Configure the batten and extension such that the distance the extension extends beyond the batten end is infinitely adjustable by the user and so the adjustment device will sustain the position of the extension when a load equal to the extension length multiplied by 20 pounds per linear foot is applied in both longitudinal directions. Size the extensions so that not less than 12 inches remains sleeved at all times. Paint the section remaining sleeved red.
   d. Weld a 1-1/4” x 3/8” diameter welded steel ring to the off-stage end of the extension so that one quadrant is partially inside the extension pipe and that the weld points are on parallel quadrants of the extension.

I. Batten Hanging Devices:
   1. Provide one type of batten hanging device within the system as described below.
   2. Batten Clamps:
      a. Provide connections to each lift line turnbuckles by removable steel clamps which encircle the complete circumference of the batten and allow for direct connection to the jaw of the turnbuckle. Employ appropriately rated fasteners with locking devices for connections.
      b. Configure the devices to each resist the complete loads of both adjacent spans with the additional imposed impact factors. Configure the devices to resist rotation of the batten with a load of 30 pounds per linear foot of the longest adjacent span applied at 12 inches horizontally from the section’s centroid.
      c. Configure devices so that the bottom and sides do not exceed the diameter of the batten by more than one batten diameter. Configure devices so that no sharp edges or corners greater than 45 degrees are presented.

3. Trim Chain:
   a. Provide 36-inches long fabricated from ¼-inch alloy, specifically designed for overhead lifting applications. Provide chain that is rated to resist the complete loads of both adjacent spans with the additional imposed impact factors.
b. Wrap chain 1 ½ times around the batten and terminate with appropriately rated and installed hardware. Provide appropriately rated fasteners and hardware with locking devices for connections.

c. Provide chain that is compatible with industry-recognized chain hardware. Chain link size shall match the Welded Steel Chain Specifications for Grade 30 Proof Coil Chain as specified by the National Association of Chain Manufacturers.

d. Provide chain that is stamped with the manufacturer’s identifying mark.

e. Provide chain that is lot traceable, with a coded date stamp on each piece of trim chain.

f. Provide chain and connection devices specifically designed for overhead lifting as defined to OSHA (29 CFR 1926.251).

g. The use of hardware not designed for connections in overhead lifting, such as bolts used as safety devices, will not be accepted.

h. Provide certification of compliance from the manufacturer for the intended application.

4. Provide batten clamps, as described above, for all lighting raceway and orchestra shell battens.

J. Index Strip Light:

1. Provide a continuous index strip light for illumination of each locking rail. Provide continuously dimmable LED strips in blue and white. Provide fixture to direct light away from the stage. Provide fixtures that have a direct DMX connection for control.

2. Configure outriggers for strip lights illuminating the lockrails at the stage floor to serve as continuous scenery bumpers without interfering with the strip light. Design and provide fixture and mounting to withstand anticipated loading and an additional 75% impact load. Provide bracing against lateral movement between outriggers. Support the strip light not less than every 5'-0", or as to prevent deflection of the housing exceeding 1/360 of span.

3. Suspend strip light from scenery bumper with rigid formed steel clamps.

4. Provide a full complement of blue and white lamps and a 50% complement of spares.

5. Coordinate with Electrical contractor regarding the wiring and wiring location of the circuits.

K. Supplementary Rigging Equipment:

1. Trim Clamps:

a. Provide grooved, five line adjustable trim clamps to accept 5, 5/8" diameter synthetic lift lines.

b. Provide the clamp from two parallel steel plated equipped with spring "fingers" to accept the lines and keep them in place under anticipated loading, when plates are tightened together.

c. Employ bolts and wing nuts, arranged to ensure equal pressure on the lines, to provide plated spacing adjustment.

d. Provide an integral eye on one plate to allow for connection of a 3/4" diameter purchase line.

2. Belaying Pins:

a. Provide belaying pins of turned Hickory or other accepted hardwood. Provide 21" long pins not exceeding 1-3/16" diameter. Engineer the pin to withstand anticipated loading conditions. Turn the top of the pin to provide a secure hand hold and to prevent the pin from dropping through the rail.

b. Treat the pins to prevent organic decay and to protect the surface of the wood from damage. Treatment shall in no way react chemically with the rope or the steel pinrail in a fashion that would cause damage or operational failure of elements of the Work.

c. Provide one pin for each pinrail hole on the lockrail and stage galleries.

3. Snatch Blocks:

a. Provide snatch blocks steel sheaves and bronze bushed bearings.

1. Acceptable Western Manila Rope Snatch Blocks T-391-B

4. Sand Bags:

a. Provide sand bags in the size and quantity specified herein. Fabricate from canvas and stitch to withstand intended loading. Fabricate the bags to result in a cylindrical pattern when filled; and provide with an interior flap to prevent leakage of the sand.

b. Clearly mark, on the bag, its weight in characters at least 2" high. Mark bags to indicate the level of the sand required to equal the capacity of the bag.
c. Securely sew a nylon web sling, appropriately sized for intended loading, to the bag to support the full designated weight. Pass the sling through a forged steel rigid eye safety hook, rated for the full load of the sandbag plus a 75% impact load.

2.04 COMPONENTS

A. Rigging Lines:
   1. Suspend lifted elements by wire ropes, unless specified otherwise herein. Determine the classification of wire rope construction to suit the system operational requirements. Unless specifically required in the Contract Documents, the Contractor's engineer shall determine the classification.
   2. Employ continuous lines from the same spool/length, free of knots, splices or mechanical fasteners along their length unless specifically required otherwise in the Contract Documents. Do not employ damaged or deformed cables. Excluding prefabricated systems, cut cable at the site from the manufacturer's spool.
   3. Wire Rope: Refer to Section 11 6100.
   4. Synthetic Laid Rope:
      a. Material: filament and staple/spun polyester wrapped around a polyolefin core.
      b. Average tensile strength: 10,500 pounds ASTM D-4268 testing.
      c. Melting point: 330°F.
      d. Progressive strength loss occurring at: 200°F.
      e. Resistant to: Chemical and limited ultraviolet corrosion, anticipated physical wear.
      f. Diameter: 3/4”
      g. Color: Black

B. Sand: Provide dry clean sand in referenced bags, free of foreign matter, weighing approximately 90# per cubic foot dry.

C. Factory Finishing Colors: Refer to Section 11 6100 for finishing requirements.

D. Signage:
   1. Refer to Section 11 6100 for signage requirements.

2.05 SOURCE QUALITY CONTROL

A. Work on the systems may be reviewed at the point of manufacture a minimum of one time during fabrication. This review will occur during the final factory checkout prior to shipping, unless the Manufacturer and Architect agree on a more advantageous inspection date.

2.06 SUPPLEMENTARY

A. Furnish equipment and hardware in addition to the items specified previously that are necessary to provide a fully working system in conformance with the intent of the Contract Documents.

PART 3 EXECUTION

3.01 ERECTION, INSTALLATION AND APPLICATION

A. Refer to Section 11 6100 for execution requirements

B. Trim sets to provide horizontal track and batten set-up.

C. Align the center of each batten with the center line of the proscenium opening.

D. Counterweight Guide Tracks:
   1. Locate a complete battery of guide tracks against the stage wall as indicated on the drawings. Extend tracks from the stage floor to the underside of the headblock beam and certify vertical.
   2. Splice joints in proper alignment free of burrs and irregularities.
   3. Align vertically and horizontally by means of slot holes punched in the fixtures at the mounting and adjusting locations. Achieve final rigid adjustment by use of lock washers.
4. Install guide track system to ensure compliance with the performance requirements of this Section and Section 11 6100.

E. Install the locking rail with appropriate connections and accessories. Install to conform with required loading conditions.

3.02 CONSTRUCTION/RIGGING

A. General:
   1. Rig the counterweight system to allow battens to reach the maximum height above the stage floor based on arbor travel and an average low trim of 4'-0" above the finished floor.
   2. Rig arbors such that, unless otherwise indicated in the documents, the dead load of the arbor is even with the floor of the loading gallery.
   3. Immediately inform the Architect of conflicts between trim height, obstructions, and arbor capacities.
   4. Rig other loads as specified in the Contract Documents.

B. Block Connection:
   1. Align blocks as required by the Drawings and accompanying schedules. Conform alignment to the requirements set forth herein.
   2. Secure blocks as per accepted mounting design. Where connection device contact is not uniform, employ shims. Perform mounting to ensure blocks are securely attached to the support structure and are immobile except by intentional user action.
   3. Configure underhung loft block alignment to use the idler sheaves in logical sequence.

C. Fiber Rope Connection and Reeving:
   1. Purchase Line Employ rope fastenings which develop not less than 75% of the manufacturer's rated breaking strength of the rope employed.
   2. Reeve typical linesets with the specified wire rope for the lift lines and 3/4" synthetic rope for the purchase lines.
   3. Employ one continuous length of rope for each purchase line. The lengthening, joining or repairing of two or more sections of rope is prohibited. Mid-line splices are unacceptable.
   4. Dead tie line with a thimble at the top of the arbor and two half hitches. Finish free end with two (2) serrated, self locking nylon cable ties. Trim ties after tightening. Whip the free end then cut. Pass the line up and over the headblock, down through the rope lock, under the tension block and tie off at the underside of the arbor, employing the same method of attachment as described above. Finish synthetic lines per manufacturer’s recommendations.
   5. Adjust the length of the line after initial stretch to ensure proper function of the tension block.

D. Counterweights: Balance battens hung with permanent attachments (connector strips, traveler tracks, etc.).

3.03 DRAPERY AND TRACK INSTALLATION

A. Install draperies as supervised by the 11 6143 Contractor.
B. Install drapery track and motors as supervised by the 11 6144 Contractor.
C. Install powered hoists as directed by the 11 6135 Contractor

3.04 ADDITIONAL INSTALLATION

A. Index Strip Lights:
   1. Suspend fixtures level and perpendicular to the proscenium wall, and to in no way interfere with the systems and equipment referred to in this Contract.
   2. Wire the strip light into the work light circuits to provide independently switched blue and white circuits.
   3. Locate the fixture illuminating the lock rail. Securely attach outriggers for the support of the lamp fixture to the wall.
B. Cable Management: Install electrical cable management as specified herein, and/or as indicated on the drawings.
C. Belaying Pins: Install belaying pins in all available pinrail locations.
D. Signage:
   1. Install signage employing mechanical fasteners.
   2. Install signage as described in 1161 00.
E. Counterweights:
   1. Store 80% of unused counterweights on the onstage side of the loading gallery, split between loading gallery elevations.
   2. Store 20% of unused counterweights on the onstage side of the rigging fly gallery.

3.05 TESTING, DEMONSTRATION AND INSTRUCTION
A. Refer to Section 11 6100 for requirements.

3.06 MANUALS, DEMONSTRATION AND INSTRUCTION
A. Provide a total of eight (8) hours of training on this equipment. Training may occur in conjunction with other systems under this contractor’s scope over multiple days.
B. Training shall be scheduled at a time agreed upon by the owner, and may not be concurrent with system commissioning and testing.
C. Provide instruction and maintenance manuals pursuant to Section 11 6100

3.07 EQUIPMENT AND COMPONENT SCHEDULES
A. See Drawings

END OF SECTION
PART 1 GENERAL

1.01 SUMMARY

A. Performance powered rigging includes static, manually and electrically operated equipment assemblies, systems and components required for locating scenic, acoustic, lighting and masking elements in variable vertical and horizontal planes.

B. Due to system integration requirements, work under this section must be installed by the same contractor installing work under 116133.

C. Alternates:
   1. The Counterweight Assist Hoists for the orchestra shell ceiling panels shall be provided as part of the Rigging alternates, both Partial Rigging and Full Rigging.
   2. The control system described for the control of the acoustical drapes shall be provided as part of the Acoustic Drapery, Drapery Track, and Drapery Motors Alternate.
   3. Counterweight Assist Hoist control system:
      a. Base bid shall include single push button controls at the locking rail.
      b. Control shall be integrated into the Acoustic Drapery control system as specified herein for the Acoustic Drapery, Drapery Track, and Drapery Motors Alternate.

D. Section Includes: Provision of materials, components, modifications, assemblies, equipment and services as specified herein. These include:
   1. Verification of site dimensions and conditions.
   2. Submission of Shop Drawings signed and sealed by a licensed Professional Engineer experienced in work of similar nature and scope and licensed in the State of North Carolina.
   3. Engineering of equipment and systems as required by the Contract Documents.
   4. Manufacture of equipment and systems as required by the Contract Documents.
   5. Scheduling, sequencing and coordination with other trades.
   6. Site supervision of equipment and systems installation specified herein and elsewhere in the Contract Documents.
   7. Commissioning and final system testing performed by manufacturer’s factory trained and authorized representative.
   8. Testing and demonstration of equipment and systems as specified herein and elsewhere in the Contract Documents.

E. Provide systems including:
   1. Counterweight assist hoists for rigging linesets supporting the orchestra shell ceiling panels.
   2. Control system.
   3. Control system integrating acoustical drapery motors by 116144.
   4. Wire raceways for motor power and control distribution.
   5. Control cable furnished to electrical contractor for installation and terminated under this section. Control cable includes both specialty cable and standard wire.
   6. Cable containment from junction boxes to equipment.
   7. Mechanical, electrical and electronic limiting devices and safety systems for the positioning and coordination of the hoist system.
   8. Additional support structures as required to support to meet the intent of the Contract Documents.
   9. Provide devices and components that are NEMA. and UL. approved for the applications. Wiring and electrical service shall be performed by a licensed electrician and conform to applicable codes.

F. Products Installed but Not Furnished Under This Section:
   1. Orchestra Shell Ceiling and rigging of electrical distribution as furnished under Section 11 61 38 Acoustical Shells and 11 61 61 Performance Dimmers and Receptacles.
   2. Performance Draperies as furnished under Section 11 61 43 Performance Drapery.
3. Performance Drapery Tracks as furnished under Section 11 61 44 Performance Drapery Track.

G. Related Sections:
   1. Division 1: General and Supplementary Requirements.
   2. Division 3: Concrete.
   3. Division 4: Masonry.
   4. Division 5: Metals.
   7. Division 11: Equipment.
      a. 116100: Performance Equipment Basic Requirements.
      d. 116143: Performance & Acoustic Draperies
      e. 116144: Performance Drapery Track
      f. 116161: Performance Dimmers and Receptacles
   8. Division 23: Mechanical.

1.02 DEFINITIONS
   A. Hemp Set: An adjustable rigging system consisting of synthetic rope, moveable loft blocks and sandbag
      counterweights.

1.03 SYSTEM DESCRIPTION
   A. Performance Requirements:
      1. Section 116100 establishes minimum requirements for the system. Where Federal, State, Local
         Legislation and consensus standards address these topics, the more stringent requirements take
         precedence. Factors listed below in no way relieve this Contractor from the sole responsibility of
         providing safe systems.
   B. Provide assemblies, cable components, connections, equipment, hardware and linkages employed in
      supporting, in whole or in part, overhead loads that are rated and designed for that application.
   C. Provide mule blocks, rollers and guides as required to provide proper alignment and maintain allowable
      fleet angles.
   D. Where specific dimensions and loading capacities have been omitted from the Contract Documents,
      determine in accordance with the requirements and intent set forth in the Contract Documents.
   E. Hoisting mechanisms shall be inherently self locking at any elevation within the specified load range.
   F. Hoists must be powered to move.
   G. The hoists shall allow for local operation. The system shall incorporate two levels of hard limits on
      motion as well as direct relation to safety interlock systems.
   H. The control system shall provide for repeatability of states.
   I. The safety interlock system shall provide feedback to the control system through addressable pressure
      sensitive, optical and mechanical interlock switches. Switching shall provide for limiting access when
      system is in use, overload cut off, prevention of shearing and crushing hazards, motion elimination
      during hazardous conditions. The safety system shall report current conditions of activated sensors and
      switches to the operating console.
   J. Performance Requirements:
      1. The following is to establish minimum safety requirements for the system. Where Federal, State
         and Local Legislation address these topics, the more stringent requirement takes precedence.
         Factors listed below in no way relieve this Contractor from sole responsibility of providing a safe
         system.
         a. Load bearing components - Minimum Safety Factor: 10
b. Maximum member deflection: L/360.

c. Hoist speed:
   1. Orchestra Shell Ceiling: 20 FPM, Single Speed, Anticipated lineset load: 3000# (confirm with owner during construction.)

d. Position Locking: Self Locking at all elevations within designated travel.

e. Leveling precision: ± 0.125” repeatability

f. System shall be capable of continuous operation under full lifted load for a minimum of one hour.

2. Counterweight assist hoists to operate at 480V 3Phase.

3. See Division 26 documents for voltage and power distribution requirements.

4. Provide guides, bracing and accessories as required to maintain proper alignment and movement.

5. This Contractor is in no way relieved from the primary responsibility to provide a safe, fully functional system.

6. The safety parameters set forth herein are intended to reflect minimum safeguards and precautions related not only to normal use of the equipment under ideal operating and loading conditions but, additionally, to anticipate equipment misuse, human error, and misjudgment. These parameters in no way relieve this Contractor from responsibility or liability arising from the Work.

K. Operational Requirements:

1. Powered movement shall only be possible after unlocking a keyswitch.

2. The principle means of controlling movement will be through button switches located at the locking rail (Base - Counterweight Assist Hoists).

3. The principle means of controlling movement will be through a portable, hand-held controller. (Alternate – Acoustical Drapery)

4. The control system shall be programmed with the necessary data to ensure that hoists may be stopped at its upper and lower positions as required for operation. Accommodate infinite intermediate stops by allowing the operator to de-energize the system movement control circuit; without requiring resetting.

5. The system shall start, stop and run smoothly and quietly without excessive shutter, vibration or jerking.

6. On operation of the controls, the hoist will only move in the direction intended.

7. Control system shall require one or more mechanical switches to be engaged by the operator during the entirety of motion, to provide “dead-man” operation.

8. Motor brake shall only be released when the motor is intentionally powered up and shall be engaged at all other times.

L. Sensing / Switching Parameters:

1. Unless specifically required otherwise, switching and sensing terminating hoist motion shall require that the situation causing the termination be rectified before hoist motion may be restarted. Start and restart of hoist motion shall require deliberate action by the operator.

2. Provide sensors and switches so as not to intrude on aesthetic or functional qualities of the facility and lift system.

3. Protect sensors and switches from damage by system failures and activation.

4. Provide Emergency STOP switches as required. Coordinate locations, conduit, and wiring with Division 26 contractor.

1.04 SUBMITTALS

A. In addition to submittals required under Division 1 and Section 116100, provide manufacturer’s data and certification of compliance for all products and components.

B. Where an LCD screen is provided as part of the manufacturer’s product, provide screen images of each screen state for review prior to final programming and system commissioning.

1.05 WARRANTY

A. Special Warranty:
1. Warrant systems and equipment to be free of defective components, faulty workmanship and improper adjustment for a period of two (2) years from the date of Final Acceptance. Paint and exterior finishes are excluded relative to failure due to unusual exposure. Replace items showing evidence of defective materials or workmanship (including installation workmanship) within thirty (30) days after notification. Make replacements without cost to the Owner. Rectify conditions that might present a hazard to human life, well-being and or property within 48 hours of notification.

2. Designate warranties on manufactured equipment to the Owner on the date of Final Acceptance.

1.06 MAINTENANCE

A. Maintenance Service:
   1. Provide maintenance service for a period of two (2) years after Final Acceptance of the installation. This service consists of at least two half-yearly visits to the site for checking and adjusting of equipment during the first year, and at least one visit to the site at the end of the second year. Perform the first visit sixty days after the system has been accepted. Arrange visit to be at a time mutually agreeable to the Owner and Contractor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide the rigging systems from components (except where otherwise stated) that are the products of the following manufacturers:
   1. H&H Specialties Inc., South El Monte, CA.
   3. Texas Scenic Company, San Antonio, TX

B. Bearings:
   1. Dodge/Reliance Electric Corp., Cleveland, OH
   2. FAG Bearings Corp., Stamford, CT.
   3. Timken Co., Canton, Ohio.

C. Cable and chain connection hardware:
   1. Chicago Hardware and Fixture Company, Chicago, IL.
   2. Columbus McKinnon Corporation, Chain Division, Amherst, NY.
   3. Cooper Industries, Campbell Chain Division, Inc., NC.
   4. The Crosby Group, Inc., Tulsa, OK.

D. Compression sleeves:
   2. National Telephone Supply Company, Cleveland, OH.

E. Logic Control Systems:
   1. Allen - Bradley Co., Milwaukee, WI.
   2. General Electric Corporation, Salem, VA.
   3. Honeywell Inc., York, PA.
   4. Mitsubishi International Corp., Bensenville, IL.
   5. Westinghouse Corp., Pittsburgh, PA.

F. Motors / Brakes and Gearing:
   1. Eurodrive, Co., Bridgport, NJ.
   2. General Electric Corporation, Salem, VA.
   3. Westinghouse Corp., Pittsburgh, PA.

G. Wire Rope:
   1. Refer to 116100 for requirements.
2.02 MANUFACTURED UNITS

A. Blocks: Refer to Section 116100, Performance Machinery Basic Requirements for performance criteria.

B. Sheaves: Refer to Section 116100, Performance Machinery Basic Requirements for performance criteria.

C. Counterweight Assist Hoists
   1. Hoists shall integrate into counterweight system provided by 116133. Hoists shall be designed to fit between adjacent linesets without altering locations indicated on the drawings.
   2. Coordinate load requirements with shell manufacturer.
   3. Minimum Design Factor: 10:1
   4. See 116100 for motor, gear, brake, shaft, and other mechanical requirements.
   5. Lift / Drive Mechanism
      a. The drive medium shall allow the use of equipment provided under 116133 without modification and shall be positively driven in a manner that will allow repeatable positioning within .25”.
      b. The drive medium shall have a minimum design factor of 10:1
      c. Roller chains shall have a double leaf construction. Chain guides shall be provided to ensure positive engagement of chain and sprockets, even with slack in the drive chain.
      d. The portion of the drive medium that runs on the head block shall operate at the same pitch diameter as the lift lines so that they operate at the same speed.

D. Control Systems
   1. General
      a. Control system displays and ergonomics are subject to the approval of the Design Consultant.
      b. The system shall require a hardware keyswitch for operation. Provide six keys.
      c. Provide control positions arranged to display system conditions and status though illuminated buttons, switches, and a touch panel incorporating feedback. Provide systems developed for hostile industrial environments, repeated use and rapid control selection.
      d. Provide necessary electrical devices terminations, conduits, cables, boxes, mountings and associated equipment as required.
      e. Wiring and electrical service shall be performed by a licensed electrician. Fully fuse all devices. Provide devices and components that are NEMA. and UL. approved for the application.
   2. Mechanical and Software Limits – Counterweight Assist Hoists
      a. Provide hoists with two levels of limit switch protection in both the up and down direction.
      b. The two levels consist of: “Ultimate” limit switch, the “Normal” end of travel/position limit switch.
      c. At both the upper and lower travel limit positions, there shall be two independent mechanical limit switches:
         1. Normal end of travel/position limit switch.
         2. Top overtravel limit which shall not operate until hoist is at least 1” above normal top limit, and bottom overtravel limit which shall not operate until hoist is at least 1” below normal bottom limit.
         3. Provide switches and strikers to resist mechanical damage and abuse and to only be adjusted by use of tools.
         4. Provide overtravel limit switches of the slow action normally closed types.
      d. Normal end of travel/position limit switch shall be located to prevent mechanical wear or degradation of mechanical parts, and shall immediately stop all movement of the hoist module when struck.

E. Control Consoles, Stations, and Software Operation Systems
   1. Provide a single controller capable of controlling the Counterweight Assist Hoists and the Variable Adjustable Acoustic Drapes.
   2. Provide a portable controller and cabling in such a location that the user can see motion during operation.
3. Provide a minimum of three control screens, each for controlling Counterweight Assist hoists, Speaker Hoists, and Adjustable Acoustic Drapery Motors. Control system shall not allow for simultaneous operation of three systems.
   a. Counterweight Assist Hoist Control
      1. Only one hoist may operate at a time.
      2. In addition to upper and lower software limits, provide a minimum of 4 user programmable preset locations for each hoist. Users may program hoist position via:
         a. Input elevation value of orchestra shell
         b. Store current position.
   b. Adjustable Acoustic Drapery Motor Control
      1. Multiple drapery motors may operate simultaneously.
      2. Each drapery will have two positions:
         a. Deployed
         b. Stored
      3. Provide a minimum of 6 user programmable room presets that store the condition of each drapery to allow repeatability of that room state:
         a. Preset 1 – All Stored
         b. Preset 2 – All Deployed
         c. Presets 3-6 – User Programmable
   4. Door actuator controls
      a. Doors shall fully open prior to motion of associated drapery.
      b. Doors shall close after associated drapery motion is complete.
      c. Provide per-door override on control panel for maintenance.

F. Control Cabinet:
   1. Provide a central control cabinet housing logic control, relays, transformers, contactors, starters, safety systems and other elements required by the system control if required for the provided system. Provide the cabinet to occupy the minimal space possible.
   2. Provide drive systems fully supportable with redundant capability through interchangeable hardware. “Off the shelf parts” control system general architecture and at the component level and be available on a national level.
   3. Provide the cabinet with an integral disconnect.
   4. Provide the cabinet with an emergency Stop switch.

G. Local Motor Control:
   1. Provide a local control panel proximate to each hoist, or portable, for test purposes. Locate such that an operator is not in danger during hoist operation or failure.
   2. Include the following controls:
      a. Override keyswitch.
      b. Power on indicator lamp.
      c. Emergency Stop push button.
      d. Raise / Store button
      e. Lower / Deploy button.

H. Emergency Stop System:
   1. Provide a hard-wired emergency stop circuit utilizing a failsafe circuit conforming to NFPA 79 (Electrical Standards for Industrial Machinery) requirements.
   2. Where required due to speed and loading criteria, provide a Category 1 controlled stop per NFPA 79 (Electrical Standards for Industrial Machinery). The contractor’s Engineer shall evaluate each winch, as part of the system, to determine the type of stop required for that component.
   3. The system shall be a normally closed or supervised circuit.
   4. Resetting the emergency stop system shall not initiate motion.
   5. The system shall communicate with the control system to indicate which discrete STOP switch was pressed. Provide proper wiring infrastructure for switches to allow for discrete feedback.
   6. If additional powered rigging systems with integrated emergency stops are located within the stage area, integrate emergency stops into a unified system.
7. Emergency Stop Switches:
   a. Provide STOP switch connection faceplates as required to provide a safe operating system, and as indicated on the drawings. Coordinate conduit and wire paths with Electrical Contractor during rough-in to furnish complete system.
   b. Provide additional STOP switches in locations indicated on the drawings.
   c. Provide red mushroom head Emergency STOP Switches with press to operate.
   d. Provide Stop switches incorporating an indicator lamp which shall flash on and off rapidly when hoist is in motion and shall illuminate continuously when stop button is pressed.
   e. Clearly label Stop buttons with the words STOP HOIST.

I. Drums and Sheaves: Refer to Section 116160, Performance Systems Basic Requirements for performance criteria.

2.03 COMPONENTS
   A. Factory Finishing Colors: Refer to Section 116100 for finishing requirements.
   B. Signage: Refer to Section 116100 for signage requirements.

2.04 SOURCE QUALITY CONTROL
   A. Work on the systems may be reviewed at the point of manufacture a minimum of one time during fabrication. This review will occur during the final factory checkout prior to shipping, unless the Manufacturer and Architect agree on a more advantageous inspection date.

2.05 SUPPLEMENTARY
   A. Furnish equipment and hardware in addition to the items specified previously that are necessary to provide a fully working system in conformance with the intent of the Contract Documents.

PART 3 EXECUTION

3.01 ERECTION, INSTALLATION AND APPLICATION
   A. Refer to Section 116100 for execution requirements

3.02 CONSTRUCTION/RIGGING
   A. General:
      1. Align drums, sheaves, and associated equipment as required by the Drawings and accompanying schedules. Conform alignment to the requirements set forth herein.
      2. Secure hoists as per accepted mounting design. Where connection device contact is not uniform, employ shims. Perform mounting to ensure blocks are securely attached to the support structure and are immobile except by intentional user action.
      3. Rig other loads as specified in the Contract Documents.
   B. Block Connection:
      1. Align blocks as required by the Drawings and accompanying schedules. Conform alignment to the requirements set forth herein.
      2. Secure blocks and hoists as per accepted mounting design. Where connection device contact is not uniform, employ shims. Perform mounting to ensure blocks are securely attached to the support structure and are immobile except by intentional user action.
   C. Signage:
      1. Install signage employing mechanical fasteners.
      2. Install signage as described in 116100.

3.03 FIELD QUALITY CONTROL
   A. Reviews:
1. Final review will be made by the Architect or his appointed representative, following receipt in writing or notification from this Contractor that the installation is completed. If review reveals details of construction, fabrication, or installation not in strict accord with the Contract Documents, approval will be withheld and Contractor shall be given thirty days to replace the rejected items with those conforming to specification requirements. In addition to the final review of various equipment components the right of review is reserved during the course of the installation. The Architect or his appointed representative and will be allowed access to materials at the site for eventual incorporation in the work. Preliminary visits shall not be construed as eliminating the possible rejection of various components during the final review detailed above.

2. The completed installation of rigging equipment with draperies properly installed shall be tested and operated for the acceptance by the Architect by the Rigging Contractor prior to acceptance.

3. At the time of inspection, provide written, notarized certification that materials and methods employed, including connections, meet or exceed the requirements of the Contract Documents and applicable laws and regulations.

3.04 TESTING, DEMONSTRATION AND INSTRUCTION

A. Refer to Section 116100 for requirements.

B. Each unit to be tested by the manufacturer prior to shipment and a record of the test report included with the system manuals.

C. Provide certification of:
   1. compliance with tolerances specified in the Contract Documents.
   2. speed, noise and stability compliance with the Contract Documents.
   3. function of braking systems.
   4. motion with full specified dynamic payload.
   5. compliance of control system design, wiring and installation with manufacturer’s specifications.

D. With hoist fully loaded, perform motor current checks. Test drive unit including the effect of a loss of one or more phases, of reduced voltage and of phase reversal. Test mobile control box and all indicators. Record results of all tests.

E. Provide testing of overhead underhung hoists and controls pursuant to ASME B30.16.

F. Provide testing of overhead electric wire rope hoists pursuant to ASME HST-4.

G. Provide testing of base mounted hoist systems pursuant to ASME B30.7.

H. Provide dynamic testing of secondary brake. Tests on a prototype unit will be deemed as compliance.

I. Once installed, and prior to system commissioning, perform test on each hoist loaded to 100% capacity at maximum speed. Provide copy of testing data to architect prior to system review.

J. Provide weights for the duration of the tests, subsequent retesting and at system commissioning. Provide verification that the correct test load is provided.

3.05 MANUALS, DEMONSTRATION AND INSTRUCTION

A. See 116100 for demonstration requirements.

B. Provide a total of eight (8) hours of training on this equipment.

C. Provide instruction and maintenance manuals pursuant to Section 116100

3.06 END OF SECTION 11 61 35
PART 1 GENERAL

1.01 SUMMARY

A. Provide a Framed Proscenium Fire Safety Curtains System made of approved materials constructed and mounted so as to intercept hot gases, flames and smoke, and to prevent a glow from a severe fire on the stage from showing on the auditorium side within a period of 30 minutes. The closing of the curtain from the full-open position shall be effected in less than 30 seconds, but the last 8 feet (2438 mm) of travel shall not require less than five seconds.

B. Section Includes:
   1. Provision of materials, components, modifications, assemblies, equipment and services as specified herein. These include:
      a. Verification of site dimensions and conditions.
      b. Submission of Shop Drawings signed and sealed by a licensed Professional Engineer experienced in work of similar nature and scope and licensed in the state of Installation.
      c. Engineering of equipment and systems as required by the Contract Documents.
      d. Manufacture of equipment and systems as required by the Contract Documents.
      e. Scheduling, sequencing and coordination with other trades.
      f. Site supervision of equipment and systems installation specified herein and elsewhere in the Contract Documents.
      g. Testing and demonstration of equipment and systems as specified herein and elsewhere in the Contract Documents.

C. Provide systems including:
   1. Electrically powered Line Shaft Hoist Operated Proscenium Fire Safety Curtain including smoke pockets and controls.
   2. Additional support structures as required to meet the intent of the Contract Documents.
   3. Provide devices and components that are NEMA. and UL. approved for the applications. Wiring and electrical service shall be performed by a licensed electrician and conform to applicable codes.
   4. Provide electrical curtain release systems and associated detectors, control panels and components which are compliant with NFPA 72 National Fire Alarm Code for Local Fire Alarms and Remotes Stations Fire Alarm Systems and approved by Underwriters Laboratories for the applied use.

D. Related Sections:
   1. Division 1: General and Supplementary Requirements.
   2. Division 3: Concrete.
   3. Division 4: Masonry.
   4. Division 5: Metals.
   7. Division 11: Equipment.
      a. 11 6100: Performance Machinery General Requirements.
      b. 11 6133: Performance Manual Rigging
      c. 11 6135: Performance Powered Rigging
   8. Division 23: Mechanical.
   10. Division 28: Electronic Safety and Security

1.02 SYSTEM DESCRIPTION

A. Performance Requirements:
1. Section 11 6100 establishes minimum safety requirements for the system. Where Federal, State and Local Legislation address these topics, the more stringent requirements take precedence. Factors listed below in no way relieve this Contractor from the sole responsibility of providing safe systems. The minimum standards for construction and installation shall meet or exceed the requirements of the International Building Code (per project), NFPA 80 – 20 (2016), and ANSI E1.22 (2009) except as modified by these specifications. Where standards requirements conflict, the construction shall conform to the following order: Federal, State, and Local Legislation; Applicable Project Building Code; NFPA 80; ANSI E1.22; these specifications.

2. Provide the curtain to hang, in raised position, above the most critical sight line from the end seat of the first row of auditorium seats. Provide the smoke seals not more than 6" above the proscenium opening on the stage side of the proscenium wall in such a manner as to not interfere with the operation of the Proscenium Fire Safety Curtain. Configure to contact top seal and batten when curtain is in the lowered position.

3. Provide a framed fire safety curtain assembly that is engineered to the requirements indicated herein, and meets the requirements of NFPA 80 (2016) – 20.4.3, and ANSI E1.22 (2009) Section 4.

4. Provide the fixed speed line shaft hoist to raise the Proscenium Fire Safety Curtain under powered control and lower the curtain by both powered control or automatic release. An alternate hoist configuration will be acceptable at the discretion of the contractor’s Professional Engineer, and as approved by the Architect provided it meets the intent of the Contract Documents.

5. The hoist shall achieve a 30 fpm. rate of speed when raising curtain. Provide the hoist in an electrohydraulic configuration so that the motive force is solely electrical and the hydraulic systems are employed solely to govern the descent speed of the Curtain. Provide the hoist with proper guarding and enclosures with appropriate access panels for maintenance; enclosure should not interfere with the operation of the fire safety curtain or any other system.

6. Provide a damper for checking the free emergency descent of the curtain. Calibrate damper to retard the last eight feet (8'-0") of fall as to require not less than five seconds and with the full closure cycle requiring not more than thirty seconds with the curtain settling to the floor without shock. Damper shall be activated by the number of hoist drum revolutions. Provide damper with calibrated signage to permit calculated adjustment of descent. The damper shall in no way prevent the Curtain from achieving a complete closed seal.

7. Secure the hoist to withstand anticipated loads imposed by the system and as required by applicable codes, legislation and conventions. Do not interfere with or obstruct the operation or safety of any other systems present. Provide the hoist and mounting structure to minimize lateral and resultant forces developed by the system from being transmitted to the facility structure.

B. Provide assemblies, cable components, connections, equipment, hardware and linkages employed in supporting, in whole or in part, overhead loads that are rated and designed for that application. Base loading for each component on the maximum percentage of the capacity of the set in which the component is employed. Base the set capacity on the weight of the battens, curtain and supporting elements inclusive of an imposed wind load of two (2) pounds per square foot (95.8Pa) over the entire area of the curtain.

C. Provide mule blocks, rollers and guides as required to provide proper alignment and maintain allowable fleet angles.

D. Provide systems designed to reflect safeguards and precautions related not only to normal use of the equipment under ideal operating and loading conditions but, additionally, to anticipate equipment misuse, human error, and misjudgment. Design and intent parameters set forth herein in no way relieve this Contractor from responsibility or liability arising from the Work.

1.03 INTEGRATION WITH BUILDING ALARM SYSTEM

1. Alarm system actuation by Proscenium Fire Safety Curtain
   a. Coordinate with the fire alarm contractor to provide an interface to notify the alarm system of an emergency closure of the Proscenium Fire Safety Curtain.
   b. Integrate a provision in the alarm system such that the Proscenium Fire Safety Curtain emergency release may be tested on a regular basis without triggering a full building alarm event.
2. Proscenium Fire Safety Curtain actuation by Fire Alarm
   a. When the building alarm system is composed of addressable notification devices, provide an
      interface to actuate a fire curtain release only when an alarm is triggered in the stage and/or
      audience zone.
   b. Unless specifically required by the Authority Having Jurisdiction, the Proscenium Fire Safety
      Curtain should not be actuated by an alarm initiated outside of the stage and/or audience zone.
   c. Coordinate device actuation requirements with the fire alarm contractor.

1.04 SUBMITTALS
A. In addition to submittals required under Division 1, provide manufacturer’s data and certification of
   compliance.

1.05 WARRANTY
A. Special Warranty:
   1. Warrant systems and equipment to be free of defective components, faulty workmanship and
      improper adjustment for a period of two years from the date of Final Acceptance. Paint and exterior
      finishes are excluded relative to failure due to unusual exposure. Replace items showing evidence
      of defective materials or workmanship (including installation workmanship) within thirty (30) days
      after notification. Make replacements without cost to the Owner. Rectify conditions that might
      present a hazard to human life, well-being and or property within 48 hours of notification.
   2. Designate warranties on manufactured equipment to the Owner on the date of system acceptance.

1.06 MAINTENANCE
A. Maintenance Service: Provide maintenance service for a period of one year after Final Acceptance. This
   service consists of at least two half-yearly visits to the site for checking and adjusting of equipment.
   Perform the first visit six months after the system has been accepted. Arrange visit to be at a time
   mutually agreeable to the Owner and Contractor.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Provide the rigging systems from components (except where otherwise stated) that are the products of
   one of the following manufacturers:
   2. H&H Specialties Inc., South El Monte, CA.
   3. Texas Scenic, San Antonio, TX

B. Bearings:
   1. Dodge/Reliance Electric Corp., Cleveland, OH
   2. FAG Bearings Corp., Stamford, CT.
   3. Timken Co., Canton, Ohio.

C. Cable and chain connection hardware:
   1. Chicago Hardware and Fixture Company, Chicago, IL.
   2. Columbus Mckinnon Corporation, Chain Division, Amherst, NY.
   3. Cooper Industries, Campbel Chain Division, Inc., NC.
   4. The Crosby Group, Inc., Tulsa, OK.

D. Compression sleeves:
   2. National Telephone Supply Company, Cleveland, OH.

E. Fire Curtain Control Panels:
   1. Fire-Line Alarms, Northford, CT.
   2. Honeywell, Inc., Morris Township, NJ
F. Guide tracks:
   1. Unistrut Corporation, Atkore International, Harvey, IL
   3. Automatic Devices Co. (ADC), Allentown, PA.

G. Wire Rope:
   1. Refer to current QPL-83420 for qualification certified manufacturers.

H. Proscenium Fire Safety Curtain:
   1. W.E. Palmer Company
   2. Newtex Industries, Inc.

2.02 MATERIALS


2.03 MANUFACTURED UNITS

A. Blocks: Refer to Section 11 6100, Performance Machinery Basic Requirements for performance criteria.

B. Drums and Sheaves: Refer to Section 11 6100, Performance Machinery Basic Requirements for performance criteria.

C. Proscenium Fire Safety Curtain:
   1. Fabric
      a. The fabric used for this curtain shall be 2-1/2 lb. per square yard, nickel-wire inserted, 100% glass yarn fabric, coated on both sides with a special high temperature coating. Wire may be omitted if contractor can substantiate by approved tests that the curtain meets or exceeds all applicable requirements.
   2. Construction
      a. The Fire Safety Curtain shall have a finished size so that it will overlap the proscenium opening 18 inches on each side and 24 inches at the top, and store above the proscenium opening in a minimum amount of space.
      b. A 3-inch yielding pad of non-combustible material shall be installed at the base of the curtain to form a seal against the stage floor. Smoke seal “flap” shall be provided at curtain top edge to bridge the gap between curtain top and proscenium wall. Curtain top edge shall be suspended from overhead roof steel.
      c. Provide roller guides at each side of curtain to guide the curtain along a guide track. Guides must be attached 18-inch O.C. to reinforced curtain edges. Run guide tracks within the smoke pockets, between the roof steel and the stage floor.
   4. Unacceptable: Untested fabrics or fabrics incorporating asbestos.

D. Smoke Pockets
   1. Construct smoke pockets of required structural steel supports and steel plate to form a C shape at each side of the proscenium arch.
   2. Locate the pocket such that it cannot be seen from the audience. Extend the pocket from the stage floor to a height of 1'-0" above the top of the raised fire safety curtain or to the grid or roof steel whichever is less.
   3. Incorporate a steel track channel in which the curtain roller guides engage.
   4. Anchor the pocket to the proscenium wall as required to meet the force requirements described herein.
   5. Provide one smoke pocket at each side of the proscenium arch.

E. Pipe Battens:
1. Provide typical pipe battens of seamless black wrought steel pipe as specified in herein. Provide splices from sleeved tubing arranged so the spliced batten equals or exceeds the strength of the continuous batten material. Secure splices using removable, appropriately rated threaded fasteners in a fashion that no part of the fastener extends beyond the batten surface by more than $\frac{1}{2}''$. Arrange splices to ensure batten deflection in any span does not exceed the deflection of a continuous batten of equal span under the loading criteria specified herein.

F. Batten Hanging Devices:
   1. Provide one type of batten hanging device within the system as described below.
   2. Batten Clamps:
      a. Provide connections to each lift line turnbuckles by removable steel clamps which encircle the complete circumference of the batten and allow for direct connection to the jaw of the turnbuckle. Employ appropriately rated fasteners with locking devices for connections.
      b. Configure the devices to each resist the complete loads of both adjacent spans with the additional imposed impact factors. Configure the devices to resist rotation of the batten with a load of 30 pounds per linear foot of the longest adjacent span applied at 12 inches horizontally from the section’s centroid.
      c. Configure devices so that the bottom and sides do not exceed the diameter of the batten by more that one batten diameter. Configure devices so that no sharp edges or corners greater than 45 degrees are presented.
      d. Mark clamps pursuant to OSHA 29 CFR 1926.251(a)(4).
   3. Trim Chain:
      a. Provide 36-inches long fabricated from $\frac{1}{4}$-inch alloy, specifically designed for overhead lifting applications. Provide chain that is rated to resist the complete loads of both adjacent spans with the additional imposed impact factors.
      b. Wrap chain 1 $\frac{1}{2}$ times around the batten and terminate with appropriately rated and installed hardware. Provide appropriately rated fasteners and hardware with locking devices for connections.
      c. Provide chain that is compatible with industry-recognized chain hardware. Chain link size shall match the Welded Steel Chain Specifications for Grade 30 Proof Coil Chain as specified by the National Association of Chain Manufacturers.
      d. Provide chain that is stamped with the manufacturer’s identifying mark.
      e. Provide chain that is lot traceable, with a coded date stamp on each piece of trim chain.
      f. Provide chain and connection devices specifically designed for overhead lifting as defined to OSHA (29 CFR 1926.251).
      g. The use of hardware not designed for connections in overhead lifting, such as bolts used as safety devices, will not be accepted.
      h. Provide certification of compliance from the manufacturer for the intended application.

G. Rate of Rise Detectors: Provide UL listed rate of rise detectors as required by the authority having jurisdiction. Rate of temperature rise of 15-20 degrees F. per minute shall cause the actuators to transmit a signal to the release system; initiating the Curtain's descent. Detectors shall continue to function in the event of a facility power loss. In addition to providing the systems as described, this Contractor is responsible for all wiring, termination and containment of detectors.

2.04 COMPONENTS

A. See Section 11 6100 for Additional Component Requirements.

B. Rigging Lines:
   1. Suspend lifted elements by wire ropes, unless specified otherwise herein. Determine the classification of wire rope construction to suit the system operational requirements. Unless specifically required in the Contract Documents, the Contractor's engineer shall determine the classification.
2. Employ continuous lines from the same spool/length, free of knots, splices or mechanical fasteners along their length unless specifically required otherwise in the Contract Documents. Do not employ damaged or deformed cables. Excluding prefabricated systems excluded, cut cable at the site from the manufacturer's spool.

3. Wire Rope: Refer to Section 11 6100.

C. Chains: Proscenium Fire Safety Curtain Safety Chains: 7/32" min. Grade 80 Chain, or meeting the requirements of Trim Chain as specified herein.

D. Fusible Links: Double eye links for loads up to 30 lbs at 160oF. Underwriters Laboratories approval required.

2.05 FACTORY FINISHING COLORS:

A. Finish all non bearing ferrous metals in enamel red, excepting smoke pockets which shall be painted flat black.

B. Do not paint sheave grooves, cable bearing surfaces, fasteners, aluminum or galvanized materials and products.

2.06 SIGNAGE:

A. Provide signage per Section 11 6100.

B. Provide signage affecting safety in accordance with ANSI Z535.2 Environmental And Facility Safety Signs including annexes.

C. Signage shall be legible both in construction and grammar. Sign surfaces and characters shall be textured or otherwise treated to minimize glare and veiling reflectance.

D. Provide signage in English.

E. Employ printed or stenciled characters. Handwritten characters are not acceptable.

F. Wall mount diagrams depicting the system layout and maximum load limitations (drawn not less than 1/4"=1'-0") in a protective transparent faced frame on the stage wall near the locking rail and near the loading gallery entrance as to be plainly visible, and as not to interfere with the operation of the system.

G. Provide, adjacent to each Proscenium Fire Safety Curtain pull ring box, in plain view, a painted metal sign with 3” high white sans serif characters on a red background; bearing the inscription: "IN CASE OF FIRE, PULL RING TO LOWER PROSCENIUM FIRE SAFETY CURTAIN" with an indicator clearly pointing to the location of the ring. Character minimum height 0.840” sans serif.

H. Label the Proscenium Fire Safety Curtain control box: "PROSCENIUM FIRE SAFETY CURTAIN HOIST CONTROL IN CASE OF EMERGENCY USE PULL RING BOXES" in white sans serif characters on a red background. Character minimum height 0.840” sans serif.

I. In locations agreed to by the Architect, provide signage at the lock rail, loading gallery, grid iron identifying all pertinent hazards, avoidance procedures and consequences. In addition to safety requirement.

2.07 SOURCE QUALITY CONTROL

A. Work on the systems may be reviewed at the point of manufacture a minimum of one time during fabrication. This review will occur during the final factory checkout prior to shipping, unless the Manufacturer and Architect agree on a more advantageous inspection date.

2.08 SUPPLEMENTARY

A. Furnish equipment and hardware in addition to the items specified previously that are necessary to provide a fully working system in conformance with the intent of the Contract Documents.
PART 3 EXECUTION

3.01 ERECTION, INSTALLATION AND APPLICATION
A. Refer to Section 11 6100 for execution requirements
B. Install curtain, track, winch, and other required components.

3.02 CONSTRUCTION/RIGGING
A. Rig other loads as specified in the Contract Documents.
B. Drum and/or Block Connection:
   1. Align drums and/or blocks as required by the Drawings and accompanying schedules. Conform alignment to the requirements set forth herein.
   2. Secure drums and/or blocks as per accepted mounting design. Where connection device contact is not uniform, employ shims. Perform mounting to ensure blocks are securely attached to the support structure and are immobile except by intentional user action.
   3. When used, configure underhung loft block alignment to use the idler sheaves in logical sequence.

3.03 ADDITIONAL INSTALLATION
A. Signage: Install signage employing mechanical fasteners.

3.04 FIELD QUALITY CONTROL
A. Reviews:
   1. Final review will be made by the Architect or his appointed representative, following receipt in writing or notification from this Contractor that the installation is completed. If review reveals details of construction, fabrication, or installation not in strict accord with the Contract Documents, approval will be withheld and Contractor shall be given thirty days to replace the rejected items with those conforming to specification requirements. In addition to the final review of various equipment components the right of review is reserved during the course of the installation. The Architect or his appointed representative and will be allowed access to materials at the site for eventual incorporation in the work. Preliminary visits shall not be construed as eliminating the possible rejection of various components during the final review detailed above.
   2. The completed installation of rigging equipment with draperies properly installed shall be tested and operated for the acceptance by the Architect and Authority having jurisdiction by the Contractor prior to acceptance.
   3. At the time of inspection, provide written, notarized certification that materials and methods employed, including connections, meet or exceed the requirements of the Contract Documents and applicable laws and regulations.
   4. The Contractor is completely and solely responsible for any testing required by the Architect and authorities having jurisdiction to ensure compliance with the Contract Documents and applicable laws and regulations.

3.05 MANUALS, DEMONSTRATION AND INSTRUCTION
A. Provide a total of four (4) hours of training on this equipment.
B. Provide 3 copies of an instruction and maintenance manual which includes:
   1. Contractor’s and principal Manufacturer’s contact information.
   2. System description.
   3. Safety instructions and warnings.
   4. Operation Instructions.
   5. Maintenance and inspection instructions, procedures and schedules.
   7. Product literature for components employed in the system.
   8. Reduced shop drawings of this part of the project.
   9. Recommended spare parts listing.
10. Final inspection reports.

END OF SECTION
PART 1 GENERAL

1.01 SUMMARY

A. The tension wire grid consists frames supporting a woven wire rope tension grid. The grid shall provide a serviceable walking surface for technical personnel for access to and hanging locations for performance lighting and performance equipment.

B. Section Includes:
   1. Provisions as required under Division 1.
   2. Verification of site dimensions and conditions.
   3. Submission of Shop Drawings signed and sealed by a licensed Professional Engineer experienced in work of similar nature and scope and licensed in the State of installation.
   4. Engineering of equipment and systems as required by the Contract Documents.
   5. Manufacture of equipment and systems as required by the Contract Documents.
   6. Scheduling, sequencing and coordination with other trades.
   7. Site supervision of equipment and systems installation specified herein and elsewhere in the Contract Documents.
   8. Testing, demonstration, and certification of equipment and systems as specified herein and elsewhere in the Contract Documents.

C. Provide a tension wire grid system consists of:
   1. Fixed steel frames supporting a woven wire rope tension grid spanning the dimensions provided in the drawings.
   2. Removable modular woven wire panels in the shape and configuration shown on the drawings.
   3. Support hangers from ceiling structure.
   4. Fixed and operable railings.
   5. Kickrails
   7. Installed and loose lighting pipe.
   8. Pipe connection accessories.
   9. Hanger and grid bracing as required by the contractor’s engineer.
   10. Components, labor and elements necessary to complete the system as specified in the Contract Documents.
   11. Signage

D. Related Sections:
   1. Division 1: General and Supplementary Requirements.
   2. Division 3: Concrete.
   3. Division 4: Masonry.
   4. Division 5: Metals.
   7. Division 11: Equipment.
      a. 116100: Performance Machinery General Requirements.
      b. 116143: Performance and Acoustic Draperies.
      c. 116144: Performance Drapery Track
   8. Division 23: Mechanical.

1.02 SYSTEM DESCRIPTION

A. Performance Requirements:
1. Section 116100 establishes minimum requirements for the system. Where Federal, State, Local Legislation and consensus standards address these topics, the more stringent requirements take precedence.

2. Cables, fittings, load bearing components - Minimum Safety Factor: 8 or 75% impact factor, whichever is greater.

3. Steel: 1/5 of yield.

4. Loading Criteria
   a. Grid Floor Live Load: See drawings.
   b. Allowable Concentrated Load: Per drawings, and concentrated on a 1'-0” square area.
   d. Maximum Cable deflection: 3” under 300# concentrated load.
   e. Allowable uniform and concentrated loads shall be non-concurrent.
   f. Maximum grid panel self-weight (dead load): 5psf, including frame, cable, and grid panel hardware.

5. Provide assemblies, cable components, connections, equipment, hardware and linkages employed in supporting, in whole or in part, overhead loads that are rated and designed for that application.

6. Provide systems designed to reflect safeguards and precautions related not only to normal use of the equipment under ideal operating and loading conditions but, additionally, to anticipate equipment misuse, human error, and misjudgment. Design and intent parameters set forth herein in no way relieve this contractor from responsibility or liability arising from the Work.

B. Design Requirements:
   1. Grid panels shall be designed to resist all horizontal loads associated with the design of the panel frame structure. No horizontal loads shall be imposed upon the building except for seismic loads and sway loads caused by the movement of personnel on the grid.
   2. Grid panel frames shall not exceed 2” in depth or width, except as noted on the drawings.
   3. The wire rope walking surface shall be factory tensioned and connected to the modular frame.
   4. The wire rope walking surface shall be located no more than ¼” from the top of the modular frame.
   5. Frame design shall not allow shearing or sharp bending of the wire rope walking surface.
   6. Grid panels shall be fabricated in the pattern to match the structure above.
   7. Grid panels shall facet in elevation at the points noted on the drawings to follow the elevation changes of the support structure.
   8. Cables shall be configured to align with adjacent panels.

1.03 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

B. Coordinate work with other trades doing adjoining work to assure proper fit, installation and first class results.

C. Protect grid components from corrosion, deformation, and other damage during delivery, storage, and handling.

1.04 SUBMITTALS

A. In addition to submittals required under Division 1 and Section 116100, for items listed herein, provide manufacturer’s data and certification of compliance.

B. Shop Drawings
   1. Submit complete fully dimensioned, large-scale detailed fabrication drawings of all major components. Drawings and schedules shall show all information necessary to explain fully the design features, appearance, function, fabrication, installation, and use of system components in all phases of operation. All drawings shall be signed and sealed by a licensed Professional Engineer experienced in work of similar nature and scope and licensed in the State of installation.

C. Product Data. Submit catalog or standard data sheets for component parts as part of the shop drawing submittal. The data shall include all information which indicates compliance with the specifications.
herein. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information

D. Calculations: Supply calculations demonstrating compliance with performance requirements and design criteria, including analysis data. Calculations shall be signed and sealed by a licensed Professional Engineer experienced in work of similar nature and scope and licensed in the State of installation. At a minimum, the analysis data shall demonstrate:
   1. Distribution of cable forces to the perimeter frame members based on relative stiffness of perimeter frames and wire ropes using non-linear analysis methods.
   2. Analysis of wire rope conforming to ASCE 19-10 Structural Applications of Steel cables for Buildings.
   3. Analysis of modular frame corner and internal connections as per AISC 360 Chapter K - Design of HSS Box Member Connections.

1.05 SAMPLES
A. Samples of any or all items listed below shall be sent within thirty (30) days to the Architect or Designee as directed.
B. The Architect or Designee reserves the right to make an examination of the samples as he may consider necessary to determine their quality and compliance with the specification, even to the destruction of the sample.
C. Samples for submission include:
   1. Tension Grid Panel, minimum 1-0" x 1-0". (300mm x 300mm)
   2. Sample shall be provided in the shape or proportion of the specified panel.
   3. Other items as deemed necessary by the Architect.
   4. In lieu of sample submission, Contractor may arrange for the Owner, Architect or Designee to visit completed work of similar scope at existing installations.
D. Samples shall be shipped to a location selected by the Architect for evaluation.

1.06 SIGNAGE
A. Provide signage conforming to requirements in 116100.
B. Provide 8x11 fire retardant polymer signs at each grid access locations.
C. Provide signage that includes:
   1. Maximum Live Load
   2. Maximum Point Load
   3. Identification of all pertinent hazards, voidance procedures, and consequences associated with this equipment.

1.07 WARRANTY
A. Special Warranty:
   1. Warrant systems and equipment to be free of defective components, faulty workmanship or improper adjustment for a period of two years from the date of Owner's acceptance. Paint and exterior finishes are excluded. Replace items showing evidence of defective materials or workmanship (including installation workmanship) within thirty (30) days after notification. Make replacements without cost to the Owner. Rectify conditions that might present a hazard to human life, well-being and or property within 48 hours of notification.
B. Designate warranties on manufactured equipment to the Owner on the date of system acceptance.

1.08 MAINTENANCE
A. Maintenance Service:
   1. Provide maintenance service for a period of one year after final acceptance of the installation. This service consists of at least two half-yearly visits to the site for checking and adjusting of equipment.
2. Perform the first visit sixty days after the system has been accepted. Arrange visit to be at a time mutually agreeable to the Owner and Contractor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide the tension grid panels that are the products of one of the following manufacturers.
   1. InterAmerica Stage, Inc, Sanford, FL
   2. Slingco America, Inc, Fayetteville, GA
   3. Hall Stage, Luton, United Kingdom

B. Cable and chain connection hardware:
   1. Chicago Hardware and Fixture Company, Chicago, IL.
   2. Columbus Mckinnon Corporation, Chain Division, Amherst, NY.
   3. Cooper Industries, Campbel Chain Division, Inc., NC.
   4. The Crosby Group, Inc., Tulsa, OK.
   6. JR Clancy, Syracuse, NY

C. Lighting Pipe Accessories
   1. City Theatrical, Carlstadt, NJ
   2. The Light Source, Charlotte, NC
   3. Altman Lighting, Yonkers, NY
   4. JR Clancy, Syracuse, NY

D. Compression sleeves:
   2. National Telephone Supply Company, Cleveland, OH.

E. Wire Rope:
   1. Refer to Section 116100, Performance Machinery Basic Requirements.
   2. End fittings shall be pressed stainless steel ball.
   3. 50% of wire rope terminations shall be proof tested to one half of the minimum cable breaking strength. Certification of this testing shall be provided with the O&E materials.
   4. It shall be possible for a technician to use a standard hand swaging tool to repair any grid wire without removing any grid frame or component.
   5. Wire Rope Color: Black

2.02 MATERIALS


B. Steel Shapes and Plates: ASTM A36 - Structural Steel

2.03 ACCESSORIES

A. Side Arms:
   1. Provide 24" sidearms each with two sliding tees, set screws and C-clamp adjustable for pipe up to 1.5" O.D.
   2. Acceptable Products:
      a. Safer Sidearm, City Theatrical

B. Swivel Pipe Coupler:
   1. Provide coupler with fixed screws and wing nuts for fastening pipes at varying angles, and fitting pipes between 1.25” Nom (1.66” O.D.) to 1.5” Nom (1.9” O.D.)
   2. Provide couplers that are finished matt black.
   3. Acceptable Products:
      a. Swivel Coupler, The Light Source
      b. Multiple Angle Swivel Clamp, Altman Lighting
C. 90 Degree Pipe Coupler:
   1. Provide coupler with fixed screws and wing nuts for fastening pipes at 90 degree angles, and fitting pipes between 1.25” Nom (1.66” O.D.) to 1.5” Nom (1.9” O.D.)
   2. Provide couplers that are finished matt black.
   3. Acceptable Products (Initial Layout):
      a. Mega-Coupler, The Light Source
      b. Mega Grid Lock Pipe Clamp, The Light Source
      c. Cross Grid Connector, JR Clancy
      d. Right Angle Clamp, Altman Lighting
   4. Acceptable Products (Spare):
      a. Mega-Coupler, The Light Source
      b. Right Angle Clamp, Altman Lighting

2.04 FINISHES
   A. Apply one coat (2 mils minimum) of High Performance Alkyd Metal Primer, and two coat of High Performance Protective Acrylic. Primer coat to be applied immediately after cleaning and pretreating.
   B. Color: Matte Black

2.05 COMPONENTS
   A. See 116100 for component requirements.
   B. Fasteners: Fasteners shall be rated for the anticipated loads. Provide fasteners with approved markings indicating their rating. Provide fasteners with a vibration resistant or positive locking design. Provide fastener system's components of equal ratings.
   C. Factory Finishing Colors: Refer to Section 116100 for finishing requirements.
   D. Signage:
      1. Provide 8x11 fire retardant signs at each grid access locations.
      2. Provide signage that includes:
         a. Maximum Live Load
         b. Maximum Point Load
         c. Identification of all pertinent hazards, voidance procedures, and consequences associated with this equipment.
      3. Provide an engraved black lamicoid plaque, with white characters 3/8” high. Install as directed by the Design Consultant, adjacent to each entrance to the grid
      4. Refer to Section 116100 for additional signage requirements.

2.06 SOURCE QUALITY CONTROL
   A. Work on the systems may be reviewed at the point of manufacture a minimum of one time during fabrication. This review will occur during the final factory checkout prior to shipping, unless the Manufacturer and Design Consultant agree on a more advantageous inspection date.

2.07 SUPPLEMENTARY
   A. Furnish equipment and hardware in addition to the items specified previously that are necessary to provide a fully working system in conformance with the intent of the Contract Documents.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Refer to Section 116100 for execution requirements
   B. Verification of Conditions:

100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
1. Examine work prepared by others to receive work of this Section and report defects affecting
installation to the Construction Manager for correction. Commencement of the work shall be
considered as complete acceptance of preparatory work by others. The inspection includes but is not
limited to:
   a. Assurance mounting surfaces are ready to accept the Work.
   b. Verification of flatness, plumb and level of mounting conditions.
   c. Inspection of components of the Work to ensure no damage has occurred during shipping or
      storage.
2. Discrepancies:
   a. In the event of discrepancies, immediately notify the Design Consultant.
   b. Do not proceed with the installation in areas of discrepancy until all such discrepancies have
      been fully resolved.

3.02 PREPARATION
   A. Verify field measurements at the site prior to installation and modify the system accordingly.
      1. Deliver equipment to the site only after the building has been closed in.
      2. Coordinate storage at the site and ensure the materials and components are undamaged.
      3. Protect the surrounding environment from damage by the Work.
   B. Surface Preparation:
      1. Clean surfaces as necessary prior to commencing the Work.

3.03 ERECTION, INSTALLATION AND APPLICATION
   A. Field construct and install tension grid system.
      1. Install prefabricated panels in to support structure above provided under Division 5. Make
         necessary adjustments and modifications to insure satisfactory installation.
      2. Field verify material routing and access to theatre.
      3. Install items plumb, straight, square and level in location indicated on the contract documents and
         as shown on approved shop drawings.
      4. Fit exposed connections accurately together to form hairline joints. Weld connections that are not
         to be left as exposed joints.
      5. Installation practices shall be in accordance with OSHA Safety and Health Standards and all local
         codes.
      6. All welding must be performed in full compliance with the latest edition of the Structural Welding
         Code (ANSI/AWS D1.1).
      7. Coordinate support to structure with Division 5.
      8. All finishes which are disturbed during shipping and installation shall be touched up to match the
         original finish.
   B. Install lighting pipes as indicated on drawings. Furnish additional materials to owner.
   C. Signage:
      1. Install signage employing mechanical fasteners.
      2. Install signage as described in 116100.

3.04 FIELD QUALITY CONTROL
   A. Reviews:
1. Final review will be made by the Design Consultant or his appointed representative, following receipt in writing or notification from this Contractor that the installation is completed. If review reveals details of construction, fabrication, or installation not in strict accord with the Specification and Contract requirements, approval will be withheld and Contractor shall be given thirty days to replace the rejected items with those conforming to specification requirements. In addition to the final review of various equipment components the right is reserved to inspect during the course of the installation, and to be allowed access to materials at the site for eventual incorporation in the work. Preliminary inspection will not be construed as eliminating the possible rejection of various components during the final inspection detailed above.

2. The completed installation, properly installed, shall be load tested for the acceptance by the Design Consultant by the Contractor prior to acceptance.

3.05 TESTING, DEMONSTRATION AND INSTRUCTION
   A. Refer to Section 116100 for requirements.
   B. Provide a total of four (4) hours of training on this equipment.
   C. Training shall be scheduled at a time agreed upon by the owner, and may not be concurrent with system commissioning and testing.
   D. Provide instruction and maintenance manuals pursuant to Section 116100

3.06 EQUIPMENT AND COMPONENT SCHEDULES
   A. See Drawings for quantities, dimensions and configuration.

END OF SECTION
PART 1 GENERAL

1.01 SUMMARY

A. Performance lifts include fixed speed lifting systems. The system shall be operated by a unified programmable control system and include mechanical and electronic limits, safety devices and integrate safety devices on to fascias. Finished flooring, fascia surfaces, power and trim are not included in this section. Specific lift dimensions and travels are indicated on the drawings.

1. Section includes materials, components, modifications, assemblies, equipment and services as specified herein. These include, but are not limited to:
   a. Verification of site dimensions and conditions.
   b. Submittals as required by the Contract Documents.
   c. Engineering of equipment and systems as required by the Contract Documents.
   d. Design and Shop Drawings, engineered, signed and sealed by a Professional Engineer licensed to practice by the appropriate governing authority in which the Work is installed.
   e. Manufacture of equipment and systems as required by the Contract Documents.
   f. Scheduling, sequencing and coordination with other trades.
   g. Site supervision of equipment and systems installation specified herein and elsewhere in the Contract Documents.
   h. Testing and demonstration of equipment and systems as specified herein and elsewhere in the Contract Documents.

B. Provide Work including:
   1. Orchestra pit lift platform.
   2. Low profile electro-mechanical drive lifting mechanisms inclusive of brakes, motors, gearboxes and connecting devices, motors, starters and connection to power disconnect.
   3. Additional bracing, guides and support structure specific to the system
   4. Vertical barrier net along the upstage edge of the lift with accompanying storage trough at the Machinery Level.
   5. Temporary, removable access ladder to equipment and maintenance pit.
   6. Appropriate framing, substructure and sleepers for the connection of the finished flooring, fascia panels, and trim.
   7. Mechanical, electrical, and electronic limiting devices and safety systems for the positioning and coordination of the lift system.
   8. Safety devices integrated into removable railing system at audience level and on lift platform.
   9. Programmable control system, including control cable and receptacle plates.
   10. Accessories.
   11. Additional systems and support structures as required to meet the intent of the Contract Documents.

C. Products furnished under this section and installed under Division 26
   1. Motor Control Panel
   2. Specialty backboxes as required for the operation of the system. Standard boxes and conduit are excepted from this.
   3. Multiconductor cable for the purpose of providing power and control from the floor to the lift platform.
   4. Specialty control cable or multiconductor cable as required for the operation of the lift.
   5. Low voltage and line voltage disconnects at motor and otherwise as required to meet applicable codes and legislation.

D. Related Sections:
   1. Division 1: General and Supplementary Requirements.
   2. Division 2: Sitework.
1.02 SYSTEM DESCRIPTION

A. Section 11 6100 establishes minimum safety requirements for the system. Where Federal, State and Local Legislation address these topics, the more stringent requirements take precedence. Factors listed below in no way relieve this Contractor from the sole responsibility of providing safe systems. The minimum standards for construction and installation shall meet or exceed the requirements of the Applicable Project Building Code (per project) and ANSI E1.42 (2016) except as exceeded by these specifications. Where standards requirements conflict, the construction shall conform to the following order: Federal, State, and Local Legislation; Applicable Project Building Code; ANSI E1.42; these specifications.

B. Lifting systems shall fit completely within the perimeter of the lift platform. Lifts requiring penetrations in the bearing floor, other than that required for mounting and power supply, are not acceptable.

C. Lifting mechanism shall use electrical motors, drives, and other non-fluid powered equipment to perform lifting.

D. The lifting mechanism shall be inherently self locking at any elevation within the specified load range without supplementary mechanical interlocks.

E. Lifts must be powered to move.

F. The control station shall allow for operation via a portable pendant from connections at the stage and pit platform. The control system shall be configured to reflect the preset lift elevations per the contract documents. The system shall incorporate user accessible feedback of system activities. The system shall incorporate limits on lift motion as well as direct relation to safety interlock systems. The control system shall provide for repeatability of programmed states.

G. The safety interlock system shall provide feedback to the control system through addressable pressure sensitive, optical and mechanical interlock switches. Switching shall provide for limiting access when system is in use, overload cut off, prevention of shearing and crushing hazards, and motion elimination during hazardous conditions, such as earthquakes. The safety system shall report current conditions of activated sensors and switches to the operating console. The control pendant shall govern lift action based on specific sensor activation.

H. Provide a local control system comprised of a local logic processor, sensors, limits, feedback and external communication features.

I. Performance Requirements:
   1. The following is to establish minimum safety requirements for the system. Where Federal, State and Local Legislation address these topics, the more stringent requirement takes precedence. Factors listed below in no way relieve this Contractor from sole responsibility of providing a safe system.
      a. Load bearing components - Minimum Safety Factor: 3
      b. Maximum member deflection: L/360.
      c. Lift Floor Framing Level: .125" in a 10'-0" radius circle.
      d. Sustaining capacity: 150 PSF + self load.
e. Lifting capacity: 50 PSF + self load + dynamic forces.
f. Concentrated Load Static or Dynamic: 1000 pounds in a 3'-0" square area.
g. Lift speed: Per Drawings
h. Maximum depth of lift in down position finished floor to top of finished lift floor: 3'-0".
i. Maximum Variation Between Preset Lift Surface Elevation and Adjacent Horizontal Surface: .125".
j. Maximum Tolerance Between Lift Edge and Adjacent Surface: 0.375".
k. Maximum Deviation From Plumb in X and Y Axes throughout Travel: 0.125".
l. Position Locking: Self Locking at all elevations within designated travel.
m. Leveling precision: ± 1/8" repeatability
n. Lift system shall be capable of continuous operation under full lifted load for a minimum of one hour.
o. Maximum Gap between finished lift floor and adjacent fixed floor: 0.314".

2. Provide guides, bracing and accessories as required to maintain proper alignment and movement.
3. This Contractor is in no way relieved from the primary responsibility to provide a safe, fully functional system.
4. The safety parameters set forth herein are intended to reflect minimum safeguards and precautions related not only to normal use of the equipment under ideal operating and loading conditions but, additionally, to anticipate equipment misuse, human error, and misjudgment. These parameters in no way relieve this Contractor from responsibility or liability arising from the Work.

J. Operational Requirements:
1. Powered lift movement shall only be possible after unlocking a keyswitch.
2. The principle means of controlling lift movement will be through a portable hand held pendant type controller, located at stage level.
3. The control system shall be programmed with the necessary data to ensure that the lift may be stopped at each of the preset positions shown in the drawings. Accommodate infinite intermediate stops by allowing the operator to de-energize the system movement control circuit; without requiring resetting.
4. The lift shall start, stop and run smoothly and quietly without excessive shutter, vibration or jerking.
5. On operation of the controls, the lift will only move in the direction intended.
6. Motor brake shall only be released when the motor is intentionally powered up and shall be engaged at all other times.

K. Sensing / Switching Parameters:
1. Unless specifically required otherwise, switching and sensing terminating lift motion shall require that the situation causing the termination be rectified before lift motion may be restarted. Start and restart of lift motion shall require deliberate action by the operator.
2. Provide sensors and switches so as not to intrude on aesthetic or functional qualities of the facility and lift system.
3. Protect sensors and switches from damage by system failures and activation.
4. Provide Emergency STOP switches as required.
5. Emergency STOP switches shall interface with central control system.
6. Operator contact switches for controlling motion of the lift shall be of the momentary contact type. Release of pressure on the switch shall cause lift motion to stop.
7. Provide continuous protection for lift edges and surfaces which have the potential of developing situations of entrapment, shearing, crushing, jamming or similar situations which may result in bodily injury, damage or destruction to property. Activation of such sensing shall cause the lift to immediately cease motion, but allow for motion in the reverse direction in order to clear the obstruction. Provide the system to ensure the response time is sufficient to prevent injury and damage from occurring. In the event that additional sensors are activated during the reverse motion, the lift motion shall be completely stopped.
8. Provide door interlocks for all doors adjacent to the lift area. Provide sensor / interlock to prevent:
   a. Opening of doors adjacent to lift zone to be opened when lift system is energized.
   b. Operation of the lift when a door adjacent to the lift zone is open.
9. Provide emergency release devices on door interlocks.
   a. Provide a mushroom-style Emergency Stop switch on the pit side of the door to allow proper egress in an emergency situation. Mushroom switches should be illuminated any time the associated door lock is engaged.
   b. Provide a keyed override switch on the exterior of the door. Keys for switch should match between all overrides and controls. Provide a minimum of two keys for each switch location.
10. Provide sensing to detect overloading. Where lifting capacity is exceed, the operation of the lift will not be permitted and feedback shall be reported to the control panel. In lieu of mechanical overload detection, the contractor may, at his discretion, provide current monitoring within the system such that a current draw above the initial surge required to move the lift at maximum capacity will prevent motion of the lift.
11. Provide overtravel limit switches, which when activated shall immediately cause the lift to stop.
12. Provide sensing to prevent lift motion in the event that the guide tracks are obstructed.
13. Provide closed loop telemetry to the control system allowing absolute positioning and status identification of the lift.
14. Provide position feedback to 11 6170 contractor of lift location to automatically adjust front fill speakers.
15. Provide position feedback to 11 6161 contractor of lift location to automatically illuminate safety edge light.

L. Occupant Notification:
   1. Provide an audible warning not less than 10db higher than the anticipated ambient noise, in accordance with applicable legislation. Activation of the lift shall cause the warning to sound. Provide the control station with a per use override for the warning.
   2. Provide visible indicators, such strobes or rotating beacons to provide notice of lift movement to the hearing impaired. Provide the control station with a per use override for the visible beacon. Coordinate type and location of the beacon with legislative authorities and the Architect.
   3. Overrides for visual and audible notifications should be capable of being used simultaneously. Overrides will reset to normal condition following a power cycling of the controller, or unplugging and re-plugging the hand held pendant.

1.03 WARRANTY
A. Special Warranty:
   1. Warrant systems and equipment to be free of defective components, faulty workmanship or improper adjustment for a period of two years from the date of Final Acceptance. Paint and exterior finishes are excluded. Replace items showing evidence of defective materials or workmanship (including installation workmanship) within thirty (30) days after notification. Make replacements without cost to the Owner. Rectify conditions that might present a hazard to human life, well-being and or property within forty eight (48) hours of notification.
   2. Designate warranties on manufactured equipment to the Owner on the date of Final Acceptance.

1.04 MAINTENANCE
A. Maintenance Service:
   1. Provide maintenance service for a period of two years after Final Acceptance of the installation. This service consists of at least two half-yearly visits the first year, and a third visit the second year to the site for checking and adjusting of equipment. Perform the first visit six months after the system has been accepted. Arrange visit to be at a time mutually agreeable to the Owner and Contractor.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Lift Systems
   1. GALA Systems Corp, St. Hubert, Quebec.
2. SERAPID U.S.A., Inc, Sterling Hts, MI

B. Sensors and switches:
1. Allen - Bradley Co., Milwaukee, WI.
2. Bircher Reglomat, Elk Grove, IL.
3. General Electric, Co., Plaineville, CT.
4. Mitsubishi International Corp., Bensenville, IL.
5. Square D Co., White Plains, NY.
6. Tapeswitch Corp., Farmingdale, NY.

C. Logic Control Systems:
1. Allen - Bradley Co., Milwaukee, WI.
2. Honeywell Inc., York, PA.
3. Mitsubishi International Corp., Bensenville, IL.

D. Bearings:
1. Dodge/Reliance Electric Corp., Cleveland, OH
2. FAG Bearings Corp., Stamford, CT.
3. Timken Co., Canton, Ohio.

E. Motors / Brakes and Gearing:
1. Eurodrive, Co., Bridgport, NJ.
2. Baldor Electric Company, Fort Smith, AR
3. TECO-Westinghouse Corp., Round Rock, TX.

2.02 MANUFACTURED UNITS

A. Control Systems:
1. Control Cabinet
   a. Provide a central control cabinet housing logic control, relays, transformers, contactors,
      starters, drives, safety systems and other elements required by the system control. Provide
      the cabinet to occupy the minimal space possible.
   b. Provide the cabinet with an integral disconnect.
   c. Provide the cabinet with an emergency Stop switch.

2. Limit Switches
   a. Top overtravel limit shall not operate until lift is at least 1” above normal top limit and bottom
      overtravel limit shall not operate until lift is at least 1” below normal bottom limit.
   b. Provide overtravel switches located on the lift guides and actuated by adjustable strikers on
      the lift structure. Neatly install and conceal from public view switches, strikers, wiring and
      conduits behind removable access panels.
   c. Provide switches and strikers to resist mechanical damage and abuse and to only be adjusted
      by use of tools.
   d. Provide overtravel limit switches of the slow action normally closed types.

3. Safe Edges
   a. Provide lift edges, lift fascia edges and adjacent fixed floor shear edges with safe edges
      configured stop the lift and prevent injury to personnel or damage to equipment. If site
      inspection reveals any unanticipated toe or finger traps, provide additional safe edge devices
      as necessary unless these dangers can be removed by other means.
   b. Install safe edges on the underside edges of the surrounding floor, lift structure and fascia
      panels. Install as close as possible to the edge they are protecting.
   c. Connect safe-edge sections such that fail safe operation is maintained. Disconnection or
      damage to any part of the safe edge system shall indicate a fault and no lift motion will be
      possible.
   d. Unless specified otherwise, safe edges may be custom designed suspended steel sections
      operating limit switches, tape switches, fibre optic sensors or optical detectors provided that
      their integrity is continuously monitored while the lift controls are powered and any fault
      condition renders the lift inoperable.
e. Provide continuous safe edges with no gaps. If joints are unavoidable then configure these joints so that the safe edge is effective across the joint. In employment of suspended steel section safe edges, do not exceed .25” between sections.

f. Where curved safe edges are indicated, provide smooth radii; without kinks or sharp bends, which closely follow the edge they are protecting without discontinuities.

g. Install safe edges with mechanical fasteners to resist anticipated wear and abuse. Glue or staple fixing is not acceptable.

h. Install safe edges on the surrounding floor and fixed fascias to be fitted after the finished floor and fascias are complete.

i. Provide safe edge devices sufficiently sensitive to prevent bodily injury or property damage, but able to withstand damage due to everyday use.

4. Emergency Stop Switches

a. Provide Stop switches as indicated on the drawings, and as required by authorities having jurisdiction. Integrate emergency stop system with other powered rigging systems located on and around the stage. Depressing of another system’s emergency stop switch shall stop lift motion, and in turn, depressing the lift’s emergency stop switch shall stop other hoist motion.

b. Provide red mushroom head Emergency Stop Switches with press to operate, twist to release mechanism. Operation shall disconnect power to lift by opening line contactors wired prior to the starter/reversing contactor.

c. Emergency door release switches shall illuminate continuously at any time the associated door lock is engaged.

d. Clearly label Stop buttons with the words STOP LIFT.

B. Lift Table Structure

1. Provide a platform subfloor configured to mount on lifting mechanisms and to support the finished floor and anticipated loadings. Provide the support framework of rolled or extruded steel or aluminum sections.

2. Provide framing floor joists on a minimum of 24” centers, perpendicular to the upstage wall of the stage. Ensure tops of all joists are accurately level within the tolerances specified in the Contract Documents.

C. Lifting Mechanism

1. Provide fixed structures for the support of lifting elements, transmission components, motors and guides. Obtain approval from the Architect for connections to structural and architectural elements.

2. Provide lifting mechanisms that are inherently self sustaining under anticipated load condition and which do not exhibit creep or settlement over extended time.

3. Provide lifting mechanism to permit sufficient lift travel at top and bottom for operation of overtravel limits and deceleration following failure of normal limits.

4. Provide oil tight drip trays beneath potential sources of leaks or spills to prevent oil contaminating floors or equipment.

D. Guide System

1. Provide the lift with guides to prevent lateral movement. Provide guide rails and shoes to ensure lateral stability to the platform throughout its travel without restricting vertical motion.

2. Provide tolerance between shoe and guide rail so as not to allow perceptible horizontal motion of the lift but to compensate for slight misalignments of guides or thermal expansion. Ensure that guides cannot bind or drag.

3. Do not employ guide systems requiring lubricant on guide tracks for proper operation. Protect guides from corrosion under normal indoor environmental conditions.

4. Provide guides capable of withstanding malfunctions of the lift.

5. Conceal guide tracks and guides from public view behind removable panels, with a slot open for the guide arm sized to allow anticipated movement while presenting a minimum exposure of the guide track.

E. Vertical safety net
1. Provide a safety net on the upstage, underside of the lift deck which extends to the floor of the machinery level. When the lift is at the stage floor level, hang the safety net within 3” of the upstage edge of the pit lift deck to prevent personnel and equipment from falling into the machinery level. When the lift is at the orchestra pit level, collect the safety net in a trough mounted at the machinery level.

F. Fascia Panels Support
1. Provide steel tube frames as required for the installation of fixed fascia panels. Coordinate size, shape, and placement of frames with panel manufacturer.

G. Guide Track Covers Support
1. Provide framing as required for the installation of guide track covers for each track.
2. Guide track covers shall in no way inhibit the operation of the lift. Track covers shall cover the complete track with the exception of the area proximate to the lift guide arm and shoe.

H. Signage
1. Provide signage affecting safety in accordance with ANSI Z535.2 Environmental And Facility Safety Signs including annexes.
2. Signage shall be legible both in construction and grammar. Sign surfaces and characters shall be textured or otherwise treated to minimize glare and veiling reflectance.
3. Wall mount diagrams depicting the system layout and maximum load limitations(drawn not less than 1/4”=1'-0") in a protective transparent faced frame on the stage wall near the Operator Control Station as to be plainly visible, and as not to interfere with the operation of the system. Provide an additional diagram adjacent to the Motor Control Panel.
4. Labels: Self adhesive labels, reflective yellow characters on a black background. Characters Provide an engraved black lamacoid plaque, with white characters .375” next to the loading diagrams. Engrave a warning on the plaque cautioning against unauthorized and untrained personnel operating the system.
5. Provide and fix in position a lamacoid loading notice located on DSR proscenium wall adjacent to the Operator Control Station. Letter in 1” high sans serif typeface lettering in white on green background:-

ORCHESTRA LIFT
NO UNAUTHORIZED OPERATION
DO NOT EXCEED
MAXIMUM LOADS
xxx LBS LIFTING
xxx LBS STATIC
EVENLY DISTRIBUTED

6. Provide metal plates, at least 3” high, affixed to outside of control cabinet and to lift structure as follows:

Manufacturer's Name, Address
Telephone and Fax Number
Year Of Installation
Maximum Lifting and Static Loads
Speed

2.03 SUPPLEMENTARY
A. Provide equipment and hardware in addition to the items specified previously that are necessary to provide a fully working system in conformance with the intent of the Contract Documents.

PART 3 EXECUTION

3.01 DELIVERY
A. Materials within this contract will be delivered by the contractor to the project site.
B. Equipment furnished under Division 11 6139 for installation by Division 26 will become the responsibility of the Division 26 Contractor at such time that the Division 26 Contractor takes possession of the equipment from the 11 6139 contractor.
   1. At this time the Division 26 Contractor will document the exact condition, breakage or damage evident in the equipment.
   2. Exact quantities will be documented.
   3. Discrepancies in the quantities and damage or unsuitability of the product for the application will be provided in writing to the 11 6139 contractor upon transfer of the equipment.
   4. Acceptance of the equipment verifies proper physical condition of the product. Electrical functionality is not implied at acceptance and is not the responsibility of the Division 26 Contractor.

3.02 ERECTION, INSTALLATION AND APPLICATION

A. Install Lift, Control System, Safety systems, and other systems as required by the Contract Documents.
B. Interface
   1. Coordinate with the Division 26 Contractor in accordance with the contract documents.
   2. Coordinate with removable railing manufacturer and other trades to integrate required sensors.
   3. Contract documents are diagrammatic and indicate general arrangement of systems and work included.
   4. Follow drawings in laying out work and check drawings of other trades relating to work to verify spaces in which work is installed.
C. Activate lift and demonstrate over full travel before flooring work commences.
D. Prior to installation of finished flooring, demonstrate that the top steel surfaces of the platforms comply with the specified tolerances.
E. Coordinate the installation of surrounding areas of flooring with others to ensure that the lift is level with the fixed flooring in adjacent elevations.
F. Coordinate the installation of conduits, work light luminaries, receptacles, sound boxes, loudspeakers and associated cables with other contractors.
G. Adjust and align guide rails then lock securely in position before finished flooring, fascias and edging are installed.
H. Trim to provide horizontal lift set-up.

3.03 SUPERVISION OF INSTALLATION

A. Provide instruction and supervision to the Division 26 Contractor as it pertains to the installation of these systems. Provide the necessary personnel for coordination meetings and site visits prior to installation of systems.

3.04 INSPECTION & TESTS

A. Clearly record the date, time, details and results of all the following tests and demonstrations and any subsequent re-tests. This will form the start of a system log book to be handed over to the user after acceptance together with operation and maintenance manuals.
B. Inspect the completely assembled lift system including all mechanisms, fittings, control panels, and other equipment, and make good all deficiencies before declaring that the system is complete.
C. Demonstrate compliance with tolerances specified in the Contract Documents.
D. Take measurements of lift structure in unloaded state.
E. Measure deflection with approved instruments.
F. Verify speed, noise and stability compliance with the Contract Documents.
G. The complete electrical installation shall be tested and commissioned in accordance with the IEE Wiring Regulations.
H. Before and after installation of flooring and fascias demonstrate full lift motion in both directions.
I. Comprehensively verify the accuracy of positioning of the lift approached from both directions at the each preset levels.

J. Demonstrate controls, indicators, interlocks, visual and audible notification devices and safe edges comply with the Contract Documents.

K. The following tests should be performed as directed by the Architect or Consultant
   1. Demonstrate motion with full specified dynamic payload.
   2. With lift fully loaded, perform motor current checks. Test drive unit including the effect of a loss of one or more phases, of reduced voltage and of phase reversal. Test mobile control box and all indicators. Record results of all tests.
   3. Provide weights for the duration of the tests and any subsequent retesting. Test weights may be purpose made, sealed, stackable plastic containers filled with water in place on the platforms and drained after use or other approved test weights. Provide verification that the correct test load is provided.

L. Provide 14 days notice of all tests so that the Design Consultant or his representative may witness such tests.

M. Provide demonstration and testing as required to obtain certification by the applicable legislative authority. This Contractor is solely responsible for obtaining such certification and all costs arising therefrom. Certification is a condition of final payment.

3.05 DEMONSTRATION AND INSTRUCTION
   A. Provide a total of eight (8) hours of training on this equipment. Training shall be scheduled at a time agreed upon by the owner, and may not be concurrent with system commissioning and testing.

END OF SECTION
SECTION 11 61 43
PERFORMANCE AND ACOUSTIC DRAPERIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General, Special Supplementary General Conditions, Supplementary Conditions and Division 1 Specifications, apply to this Section.

1.02 SUMMARY
A. Performance and acoustic draperies include fabric assemblies and related connection devices required for visual masking, decoration, and scenic effects on the stage. Fabric assemblies and associated connection devices used for acoustical treatment of the performance space(s) are included in this section.

B. Section Includes:
   1. Materials, components, modifications, assemblies, equipment and services as specified herein. These include, but are not limited to:
      a. Verification of site dimensions and conditions.
      b. Submittals as required by the Contract Documents.
      c. Engineering of equipment and systems as required by the Contract Documents.
      d. Manufacture of equipment and systems as required by the Contract Documents.
      e. Scheduling, sequencing and coordination with other trades.
      f. Site supervision of equipment and systems installation specified herein and elsewhere in the Contract Documents.
      g. Testing and demonstration of equipment and systems as specified herein and elsewhere in the Contract Documents.

C. Products Furnished but Not Installed Under This Section:
   1. Products, materials and assemblies described herein shall be furnished to the Performance Rigging Contractor for coordination and installation.

   2. Furnish draperies and accessories including:
      a. Two panel velour Grand Drape.
      b. Velour Grand Valance.
      c. Velour Masking Borders.
      d. Velour Masking Legs.
      e. Two panel velour Blackouts.
      f. Scrim
      g. Cyclorama.
      h. Acoustic Control Drapes.

D. Related Sections:
   1. Division 1: General and Supplementary Requirements.
   2. Division 11: Equipment.
      a. 11 61 44: Drapery Track Systems.
      b. 11 61 33: Performance Rigging.
      c. 11 61 35: Powered Rigging.

1.03 SUBMITTALS
A. Provide scaled drawings noting drapery panel sizes, hems, pleats, and construction details. Drawings to be scaled no smaller than $\frac{1}{4}'' = 1'-0''$.

B. In addition to submittals required under Division 1, provide
   1. Color swatches of proposed material for Drapery.
   2. Samples of each type of drapery material no smaller than 6" x 6".
3. Following color choice by architect, submit a 6'-0” wide x 8’-0” tall mock-up of one acoustic drapery in the Concert Hall, including webbing, grommets, weighted chain, and lining, constructed as specified in this document.

1.04 SYSTEM DESCRIPTION
A. Construct draperies to present decorative and functional finishes. Drapery construction shall reflect the standard of care, dimensional, acoustic and aesthetic requirements specified herein and elsewhere in the Contract Documents.
   
1. Flameretardancy
   a. Provide materials that are flameretardant throughout to conform to NFPA 701 (2004) as well as other applicable Local, State, Province and Federal codes.
   b. Where required below, provide Inherently Flame Retardant (IFR) fabrics.
   c. For non-IFR fabrics, flameproof in accordance with the recommendations of manufacturers DuPont, Monsanto, or accepted equal. Materials submitted showing evidence of sprayed flameproofing is unacceptable. Employ non-hydroscopic, non-crystalline agents in the flameproofing process. Flameproof fabrics by immersion for compliance with applicable codes. Perform flameproofing in a manner to minimize stiffness in the fabric. Flameproof all fabrics prior to drapery fabrication. Provide certification of flame proofing.

2. Construct draperies to withstand and compensate for reasonable variations in environmental conditions up to 65% relative humidity, normal wear and tear and usage.

1.05 WARRANTY
A. Special Warranty:
   
1. Warrant systems and equipment to be free of defective components, faulty workmanship or improper adjustment for a period of two years from the date of Final Acceptance. Replace items showing evidence of defective materials or workmanship (including installation workmanship) within thirty (30) days after notification. Make replacements without cost to the Owner. Rectify conditions that might present a hazard to human life, well-being and or property within 48 hours of notification.

2. Designate warranties on manufactured equipment to the Owner on the date of Final Acceptance.

1.06 MAINTENANCE:
A. Maintenance Service: Provide maintenance service for a period of one year after final acceptance of the installation. This service consists of at least two half-yearly visits to the site for checking and adjusting of equipment. The first visit occurring six months after the system has been accepted. Arrange visit to be at a time mutually agreeable to the Owner and Contractor.

B. Extra Materials: Provide 30% of the total quantity of tie lines and clips. Provide three (3) square yards of each fabric type employed for use as patching.

PART 2 PRODUCTS
2.01 MANUFACTURERS
A. The following are accepted component Manufacturers:
   
1. Fabrics and materials:
   a. K-M Fabrics, Inc, Greenville, SC.
   c. JL deBall, America, Inc, New York, NY.

2. Cable and chain connection hardware:
   a. Chicago Hardware and Fixture Company, Chicago, IL.
   b. Columbus McKinnon Corporation, Chain Division, Amherst, NY.
   c. Cooper Industries, Campbell Chain Division, Inc., York, PA.
   d. The Crosby Group, Inc., Tulsa, OK.
2.02 MATERIALS

A. Fabrics: Employ fabrics of one color from the same dye lot. Employ fabrics with no split widths for drapes with fullness, and no less than \( \frac{1}{2} \) widths for drapes sewn flat. Flame retard non-Inherently Flame Retardant (IFR) fabrics prior to fabrication.

1. Cotton Velour:
   a. Material: 100% cotton, 25 OZ per linear yard based on a 54" width
   b. Backing Ends Per Inch: 40
   c. Pile Ends Per Inch: 40
   d. Picks Per Inch: 32
   e. Pile Tufts Per In.: 640
   f. Approx. Pile Height -Thousandths: 135
   g. Basis of Design – KM Mills Memorable
   h. Masking drapery color: Black
   i. Grand drapery color: Custom color TBD By Architect during the submittal process.
   j. Acoustical drapery color: Custom color TBD By Architect during the submittal process.

2. Cotton Lining:
   a. Material: 100% cotton, Ranger Cloth, 12 OZ per linear yard prior to dyeing and flameretarding based on a 54" width.
   b. Thread Count: 96x60
   c. Color: Black

3. Commando Cloth:
   a. Material: 100% cotton, 16 OZ per linear yard prior to dyeing and flameretarding based on a 48" width.
   b. Thread Count: 60x68
   c. Color: Black

4. Sharkstooth Scrim:
   a. Material: 100% cotton, 26 OZ linear yard based on a 30'-0" width.
   b. Thread Count: 8 twisted pairs/vertical inch, 22 twisted pairs/ horizontal inch
   c. Color: as per schedule.

5. Filled "leno" Cyclorama:
   a. Material: 100% cotton, 3.75# linear yard based on a 29'-0" width.

6. Muslin Cyclorama:
   a. Material: 100% cotton, 18.4 OZ linear yard based on a 110" width.
   b. Color: as per schedule.

7. Paging Handles: Double layered canvas of a dark or matching color of face fabric, sewn to lining and blind stitched to face fabric.

8. Acoustic Drape Face Velour:
   a. Cotton Velour as specified above.
   b. Acoustical Drape color: Custom color TBD By Architect during the submittal process.

9. Acoustic Drape - Inherently Flame Retardant (IFR) Lining:
   a. IFR Velour – Light as specified above.
   b. Color: Black
   c. Color: Same as Velour

B. Components:

1. Webbing Cotton Drapes: 3-1/2" wide preshrunk jute webbing.

2. Webbing – Synthetic Drapes: 4” Polyester webbing weighing not less than 2.8 oz per yard.

3. Grommets:
   a. Number 3 (7/16" hole diameter) black anodized grommets.
   b. Applicable specification: NASM16491.

4. Hook and Loop Fasteners:
   a. Black woven nylon flame retardant 1" wide fasteners.
   b. Applicable Specifications:
1. MOV Safety Standard 30
2. FAA 2853(A) & (B).
5. Thread: Air entangled, oval cross section 100% Locked filament polyester.
   a. Size: Tex 60
   b. Approximate Denier/Ply: 695x1
   c. Approximate strength: 6.8 pounds.
   d. Approximate yardage: 7,000 yards/pound.
   e. Approximate melting point: 260oC – shall not support combustion.

C. Accessories
2. Tie Lines: Solid braided black "venetian blind" or mason cord NO 4-1/2 (9/64" DIA)
3. Drapery Pocket Battens
   b. Scrim and Cyclorama: 1" nominal Schedule 40 Seamless Black Steel Pipe.

2.03 MANUFACTURED UNITS
A. Sewing and Fabrication:
1. Table drapery, as removed from bolts, across an inspection window for detecting weaving flaws and imperfections. Remove and do not incorporate detected flaws. Sew all draperies nap down. Construct fabrics and draperies as specified herein, unless otherwise noted.
2. Unless specified otherwise herein, sew fabrics with polyester filament cotton wrapped Tex 60 thread in a running interlock stitch and not less than seven stitches per inch.
3. Construct draperies with the center of the center panel of fabric on the centerline of the drape.
4. Fabricate the fabric panels to run the height of the various sections without horizontal seams. Box pleat at the top in the fullness listed, exclusive of turnback facing. Sew pleats on the face side of the drapery and reinforce across the top with jute webbing. Sew the webbing to the top of the drapery with two runs of stitching using a double needle machine with 1/2” needle spacing and heavy industrial thread on 2.75” spacing. Locate grommets in the center of the webbing width so no horizontal stitching is cut or severed. Locate grommets on each pleat on 12” centers. Employ matching thread throughout.
5. Double grommet the upper corners of each traveler section. Precisely arrange to fit double chains of master carriers regardless of whether drapery section is used right or left stage.
6. Provide full length drapery items operating from traveler tracks with nickel plated oblong spring carabineer type clips fastened in place by means of heavy nylon strap double stitched to webbing. Provide other drapery with tie lines for attachment to rigging. Employ black cotton solid braided "venetian blind" or mason cord No. 4-1/2 (9/64" DIA), 36” long, knotted and tied as tie lines.
7. Sew bottom hems 6” deep with full length items containing weighting chain in a separate pocket inside the bottom hem with chain being held 3” above extreme bottom of curtain (except where pipe batten weights are called out).
8. Lining:
   a. Provide lining of the same fullness as the face drape. Sew lining under the same webbing with the face fabric at the top and inside the bottom hem of the face fabric at the bottom. Integral shrinkage tucks equal to 6” per 15’ height of the finished curtain shall be sewn into the lining to allow for vertical adjustment due to shrinkage.
   b. Attach the face fabric and lining loosely on the sides at the turnbacks with interlocking loops and a vertical 1” webbing. Provide loops on 9” centers along the full height of the drape, starting at the bottom hem. Provide same number of shrinkage tucks in vertical webbing as are provided in the lining fabric.
9. Fabricate so that the bottom edge of the face fabric and lining is within .25” parallel with the top edge of the drapery, for true hanging across full width.
10. Fabricate so that all panel vertical seams are continuous and even, without picks, bunching, or noticeable deviations.

B. Construction:
1. House Main Curtain (Grand Drape):
   a. Fabricate the Grand Drape from fabric indicated in two lined panels to provide for bipart action. Finish each panel to the dimensions and fullness indicated on the Drapery Schedule.
   b. Face back the center edges of each panel with a 2/3 width of fabric. Finish the center edges with a double thickness of material and, in order to prevent billowing and rolling, hand-tack their entire height with three rows of continuous catch stitching spaced four inches apart. Stop the lining at the edge of this turnback and secure in place as described herein. 
   c. Provide paging handle on the back leading side of each panel and one on the offstage edge of each panel. Locate the handle 42" AFF and secure to the face material with a blind stitched canvas gusset.
   d. Fabricate the bottom of each panel with a 6" double-turned hem with chain inserted in a separate pocket 3" above the floor and placed inside the hem.
   e. Face back the offstage edges of each panel with at least 12" of fabric.

2. House Main Valence:
   a. Fabricate the Main Valence from fabric indicated. Finish each panel to the dimensions and fullness indicated on the Drapery Schedule.
   b. Face back the sides of each panel with at least 12" of fabric. Stop the lining at the edge of this turnback and secure in place as described herein.
   c. Fabricate the bottom of each panel with a 6" double-turned hem.

3. Split Blackout Drop:
   a. Provide each panel with fabric indicated and finished to the dimensions indicated in the Drapery Schedule.
   b. Face back the center edges of each panel with 6” side hems. Finish the center edges with a double thickness of material. If lined, stop the lining at the edge of this turnback and secure as described herein.
   c. Fabricate the bottom of each panel with a 6" double-turned hem.

4. Masking Legs, Borders and Tabs:
   a. Provide each panel with fabric indicated and finished to the dimensions and fullness indicated in the Drapery Schedule.
   b. Face back the sides of each panel with at least 4” of fabric. If lined, stop the lining at the edge of this turnback and secure in place as described herein.
   c. Fabricate legs with a 6” double turned bottom hem.
   d. For flat-sewn drapery, provide a separate pocket for removable 1/2" ID pipe battens inside this hem. Line batten pocket with #8 canvas duck.
   e. For drapery with fullness, sew a weighted chain inside the bottom pocket of full length drapes.
   f. Reinforce tops with webbing with brass grommets 12" OC and double grommets at both ends. Secure to batten with black 36" NO 4 black cotton tie lines.

5. Scrim and Cyclorama:
   a. Fabricate the scrims and cyclorama from seamless panels of fabric indicated herein finished to the dimensions indicated in the Drapery Schedule.
   b. Reinforce the top with webbing. Provide brass grommets and tie lines 12" OC. Provide double grommets at the ends.
   c. Fabricate the drapes with a 4” triple hem. Include a continuous duck lace pocket for a 1” ID pipe batten, triple stitched to the top of the hem so as to position the batten 1.25” above the bottom.
   d. Fabricate Cyclorama sides with 2” double turned hems and reinforced grommets 24” o.c.

6. Acoustic Drapery:
   a. Fabricate the face drape from fabric indicated in panels to provide for action described in Schedules and Drawings. Finish each panel to the dimensions and fullness indicated on the Drapery Schedule.
   b. Face back the sides of each panel with at least 4” of fabric. If lined, stop the lining at the edge of this turnback and secure in place as described herein.
c. Fabricate the bottom of each panel with a 6" double-turned hem with chain inserted in a separate pocket 3" above the floor and placed inside the hem.

d. Face back the leading edges of each panel with at least 12" of fabric.

e. Fabricate with the nap facing down.

C. Signage:
   1. Signage shall be legible both in construction and grammar.
   2. Mark the centerline of the jute webbing with indelible marker. Use a white tie line on the centerline grommet.
   3. Sew a white fabric label on the upper right and left corners of the webbing of the drape with the following information:
      a. Item Name
      b. Item Number.
      c. Dimensions.
      d. Fullness.
      e. Date of Manufacture.
      f. Three (3) blanks for flame retarding renewal dates (Non-IFR).
      g. Manufacturer.

D. Accessories
   1. Storage Hampers
      a. Provide rolling storage hampers of steel construction covered in heavy canvas. Base should be reinforced and constructed of wood or metal. Provide 4 – 3” minimum diameter swivel casters.
      b. Provide each hamper with minimum ½” plywood lid
      c. Provide each hamper with 4 loose caster “donuts” to allow stacking of hampers.
      d. Hamper Size: 19 bushel. Hamper must be able to fit through a standard 3’-0” wide door.
      e. Provide additional hampers as indicated in the Drapery and Accessory Schedule below.

   2. Drapery Storage Bags
      a. Provide storage bag constructed from canvas or polyester.
      b. Provide 1 storage bag for each stage drapery (except Grand Drape and Grand Valence), scrim, and cyclorama, sized appropriately for that drape.

E. Drapery Pipes
   1. Where legs and borders are sewn flat, provide a ½” pipe batten for each at the specified width of the drape.
   2. Provide a 1” pipe batten for each scrim and cyclorama.

2.04 SOURCE QUALITY CONTROL

   A. Tests and Inspection:
      1. Work on the systems may be inspected at the point of manufacture a minimum of one time during fabrication. This inspection will occur during the final factory checkout prior to shipping, unless the Manufacturer and Design Consultant agree on a more advantageous inspection date. In lieu of a visit to the point of manufacture, the Consultant reserves the right to request and receive additional test reports and samples pertaining to the work as well as video tape of the work in progress. Costs arising from samples and video demonstration of the work in progress shall be borne by the Contractor.

2.05 SUPPLEMENTARY

   A. Provide equipment and hardware in addition to the items specified previously that are necessary to provide a fully working system in conformance with the intent of the Contract Documents.
PART 3 EXECUTION

3.01 DELIVERY
   A. Coordinate with the Performance Rigging Contractor to ensure the scope of this section is furnished and installed as required herein.
   B. Coordinate delivery and installation.

3.02 FIELD QUALITY CONTROL
   A. Supervise on-site installation of the Work.
   B. Inspections:
      1. Final inspection will be made by the Architect or his appointed representative, following receipt in writing or notification from this Contractor that the installation is completed. If inspection reveals any detail of construction, fabrication, or installation not in strict accord with the Specification and Contract requirements, approval will be withheld and Contractor shall be given thirty days to replace the rejected items with those conforming to specification requirements. In addition to the final inspection of various equipment components the Architect reserves the right of inspection during the course of the installation, and he will be allowed access to materials at the site for eventual incorporation in the work. Preliminary inspection will not be construed as eliminating the possible rejection of various components during the final inspection detailed above.

3.03 DEMONSTRATION AND INSTRUCTION
   A. The Contractor shall arrange and demonstrate to the Owner and Architect that the drapery elements perform per this intent of these Contract Documents prior to acceptance of the draperies.

3.04 DRAPERY SCHEDULE
   A. See Drawings for Performance and Acoustical Drapery Schedule.

END OF SECTION
PART 1 GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General, Special Supplementary General Conditions, Supplementary Conditions and Division 1 Specifications, apply to this Section.

1.02 SUMMARY
A. Performance drapery tracks and hangers include equipment assemblies, systems and components required for locating draperies in horizontal planes.
B. Section Includes:
   1. Provision of materials, components, modifications, assemblies, equipment and services as specified herein. These include:
      a. Verification of site dimensions and conditions.
      b. Submittals as required by the Contract Documents.
      c. Engineering of equipment and systems as required by the Contract Documents.
      d. Manufacture of equipment and systems as required by the Contract Documents.
      e. Scheduling, sequencing and coordination with other trades.
      f. Site supervision of equipment and systems installation specified herein and elsewhere in the Contract Documents.
      g. Testing and demonstration of equipment and systems as specified herein and elsewhere in the Contract Documents.
C. Furnish Performance Drapery Track Systems to be installed under 116135.
D. Related Sections:
   1. Section 116100: Performance Machinery General Requirements
   3. Section 116133: Performance Manual Rigging
   4. Section 116135: Performance Powered Rigging

1.03 SYSTEM DESCRIPTION
A. Performance Requirements: The following establishes minimum safety requirements for the system. Where Federal, State and Local Legislation address these topics, the more stringent requirements take precedence. Factors listed below in no way relieve this Contractor from the sole responsibility of providing safe systems.
   1. Minimum factor of safety for lifted loads: 10 or a 75% impact factor, whichever is greater.
      a. Increase the factor of safety for ropes where normal operating loads include cyclic dynamic loads, as determined by the Contractor's engineer, to suit the system operational requirements for required service life.
   2. Minimum factor of safety for static loads: 8
      a. The factor of safety may be lowered, at the discretion and responsibility of the Contractor's engineer, if the static design loads are higher than the maximum lifted load.
   3. Cable bending ratio: Cable diameter x 30
   5. Bearings: Two times the required load at full speed for 2000 hours.
   6. Minimum Service Factor: 1.0
B. Provide assemblies, cable components, connections, equipment, hardware and linkages employed in supporting, in whole or in part, overhead loads that are rated and designed for that application. Base
loading for each component on the maximum percentage of the capacity of the set in which the component is employed.

C. Provide mule blocks, rollers and guides as required to provide proper alignment and maintain allowable fleet angles.

D. Provide systems designed to reflect safeguards and precautions related not only to normal use of the equipment under ideal operating and loading conditions but, additionally, to anticipate equipment misuse, human error, and misjudgment. Design and intent parameters set forth herein in no way relieve this Contractor from responsibility or liability arising from the Work.

E. Refer to 116100 for additional requirements.

1.04 WARRANTY

A. Special Warranty:
   1. Warrant systems and equipment to be free of defective components, faulty workmanship and improper adjustment for a period of two (2) years from the date of Owner's acceptance. Paint and exterior finishes are excluded relative to failure due to unusual exposure. Replace items showing evidence of defective materials or workmanship (including installation workmanship) within thirty (30) days after notification. Make replacements without cost to the Owner. Rectify conditions that might present a hazard to human life, well-being and or property within 48 hours of notification.
   2. Designate warranties on manufactured equipment to the Owner on the date of Final Acceptance.

1.05 MAINTENANCE

A. Maintenance Service:
   1. Provide maintenance service for a period of one year after Final Acceptance of the installation. This service consists of at least two half-yearly visits to the site for checking and adjusting of equipment. Perform the first visit six months after the system has been accepted. Arrange visit to be at a time mutually agreeable to the Owner and Contractor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The components (make and model) form the basis of design of the system.
   1. Where other manufacturers are known to be capable of providing equipment that meets the functional requirements of specified products they are listed.

B. Cable and chain connection hardware:
   1. Chicago Hardware and Fixture Company, Chicago, IL.
   2. Columbus McKinnon Corporation, Chain Division, Amherst, NY.
   3. Cooper Industries, Campbell Chain Division, Inc., NC.
   4. The Crosby Group, Inc., Tulsa, OK.

C. Traveler tracks and operating devices:
   1. H&H Specialties Inc. South El Monte, CA.
   2. Automatic Devices Co. (ADC), Allentown, PA.
   3. Gerriets International, Ewing, JN
   4. Triple E, Kent, GB

D. Drapery Motors
   1. H&H Specialties Inc. South El Monte, CA.
   2. Automatic Devices Co. (ADC), Allentown, PA.
   3. Gerriets International, Ewing, JN

E. Compression sleeves:
   2. National Telephone Supply Company, Cleveland, OH.

F. Wire Rope: Refer to current QPL-83420 for qualification for certified manufacturers.
2.02 MATERIALS
A. Fasteners: Fasteners shall be rated for the anticipated loads. Provide fasteners with approved markings indicating their rating. Provide fastener system's components of equal ratings.


2.03 MANUFACTURED UNITS
A. Track Systems:
   1. General:
      a. Tracks:
         1. Provide each track assembly from as few pieces as possible, free of burrs, dents and irregularities. Do not exceed manufacturer's specifications for the maximum spacing of hanger supports.
         2. Where bi-part tracks are used, overlap tracks 18”.
      b. Curtain Carriers:
         1. Provide one master carrier for each section of track. Provide each carrier with four neoprene wheels fitted with ball bearings and paired so that two wheels ride in the track on either side of the carrier slot.
         2. For pull line or motor operated tracks provide each carrier with two clamps for attachment of appropriately sized operating cord.
         3. Provide carriers with single plated swivels with 6" trim chains. Provide one single carrier for each 1'-0" of track length.
         4. For channel shaped tracks, provide tracks with end stacking (rear fold, back pack) devices to prevent on-stage "bunching" and provide drapery stacking only at offstage track ends.
   2. Channel Style Track – Type 1 for Stage Draperies:
      a. Tracks:
         1. Provide the tracks from heavy duty channel type track constructed of 14 gauge steel formed to provide parallel double tracks for carrier wheels. Except for the bottom carrier slot, the track shall be totally enclosed.
      b. Curtain Carriers:
         1. Provide carriers with urethane ball bearing wheels and a means to bypass the operating line and prevent operating line sag.
      c. End Pulley Blocks:
         1. Provide heavy-duty type end pulley blocks with 4" diameter sheaves turned and grooved to fit the 1/2" operating cord and fitted with sealed ball bearings. Provide blocks to retain the operating cord in sheave grooves. Provide double vertical sheaves on the live end of tracks and a single horizontal sheave on the dead end.
         2. Secure housings to the track.
         3. Acceptable: No. 403M Live End Pulley and No. 404M Dead End Pulley, H&H Specialties.
      d. Floor Pulley Block:
         1. Provide a floor pulley block with an 4" diameter sheave. Slot the side plates of the floor block to permit vertical adjustment of the sheave to remove up to 9" of slack in the operating line. Provide block with a locking handle to permit sheave adjustment without wrenches or other tools. Incorporate a quick release mechanism with a positive action spring plunger locking device to prevent unintentional release.
         2. Acceptable: No. 408 Adjustable Floor Block, H&H Specialties.
      e. End Stops:
1. Provide end stops at the overlapping track ends to positively stop master carrier movement when the curtain is closed.
2. Secure stops to the tracks, and provide with rubber bumpers to reduce "stop noise".

f. Additional Track Equipment:
1. Provide ½” black operating line at length required for operation.
2. For walk-along drapes, provide a ½” black line connected to the master carrier at each end of the drapery, and hanging to 4'-0" AFF.
3. Provide hardware not specified above but required to provide a properly operating system in accordance with the intent of the Contact Documents.

3. I-Style Track – Type 2 Assembly for Adjustable Acoustical Drapery
a. Tracks:
1. Provide the tracks from heavy duty type track constructed of extruded aluminum I-channel construction consisting of a center rib and top, intermediate and bottom flanges. Track should be bent to match the locations shown in the drawings.
2. Provide each track assembly from as few pieces as possible, free of burrs, dents and irregularities. Do not exceed 5'-0" on center for the maximum spacing of hanger supports.
3. Provide wall and ceiling mounted clamps and hardware for drapery track as required. Coordinate blocking requirements with General Contractor prior to construction.
4. Provide hardware not specified above but required to provide a properly operating system in accordance with the intent of the Contact Documents.
5. Provide tracks that are black in color.
6. See drawings, curtain requirements in 116143, and verify site dimensions for track length requirements.
7. Provide all mounting hardware required to mount tracks as indicated in the drawings.
8. Tracks Acceptable: H&H Type 501B Heavy Duty Curved Track, CWANA including Ceiling Hanging Clamp, Splice Clamp, End Stop, 2828, H&H Specialties.

b. Curtain Carriers:
1. Provide each master carrier with four urethane wheels fitted with ball bearings and paired so that two wheels ride in the track on either side of the center rib. Provide each carrier with two plated swivels with a 6" trim chain for curtain attachment.
2. Provide single carriers with two urethane ball bearing wheels. Provide carriers with single plated swivels with 6" trim chains. Provide one single carrier for each 1'-0" of track length.

c. End Pulley Blocks:
1. Provide heavy-duty type end pulley blocks with 6" diameter sheaves turned and grooved to fit the operating cord and fitted with sealed ball bearings. Provide blocks to retain the operating cord in sheave grooves. Provide double vertical sheaves on the live end of tracks and a single horizontal sheave on the dead end.
2. Secure housings to the track.
3. Acceptable: No. 503B Live End Pulley and No. 504B Dead End Pulley, H&H Specialties.

d. Floor Pulley Block (Manual Operation tracks):
1. Provide a floor pulley block with a 6" diameter sheave. Slot the side plates of the floor block to permit vertical adjustment of the sheave to remove up to 7" of slack in the operating line. Provide block with a locking handle to permit sheave adjustment without wrenches or other tools. Incorporate a quick release mechanism with a positive action spring plunger locking device to prevent unintentional release.
2. Arrange floor attachment such that floor inserts are flush and when the floor block is removed there are no protrusions or recesses of more than 1/4"left in the floor.
3. Acceptable: No. 508 Adjustable Floor Pulley, H&H Specialties.

e. End Stops:
1. Provide end stops at the overlapping track ends to positively stop master carrier movement when the curtain is closed.

2. Secure stops to the tracks, and provide with rubber bumpers to reduce "stop noise".

   f. Additional Track Equipment:
      1. For manually operated tracks, provide 3/8” black operating line at length required for operation.
      2. For walk-along drapes, provide a ½” black line connected to the master carrier at each end of the drapery, and hanging to 4’-0” AFF.
      3. For motor operated tracks, provide cable, sized as required.
      4. Provide hardware not specified above but required to provide a properly operating system in accordance with the intent of the Contact Documents.

B. Curtain and Track Support Pipes:
   1. Provide typical pipe battens of seamless black wrought steel pipe as specified herein. Provide splices from sleeved tubing arranged so the spliced batten equals or exceeds the strength of the continuous batten material. Secure splices using removable, appropriately rated threaded fasteners in a fashion that no part of the fastener extends beyond the batten surface by more than ½”. Arrange splices to ensure batten deflection in any span does not exceed the deflection of a continuous batten of equal span under the loading criteria specified herein.
   2. Provide pipe length depicted for each drapery on the Drawings. Provide pipes that run the full width of the stage regardless of drapery width, unless otherwise indicated on the drawings. Incorporate full pipe sections for each batten with only one partial section located on center line. Drill both ends of the battens for batten splices and extensions.

2.04 COMPONENTS

   A. Signage:
      1. Signage shall be legible both in construction and grammar.
      2. Sign surfaces and characters shall be textured or otherwise treated to minimize glare and veiling reflectance.

2.05 SOURCE QUALITY CONTROL

   A. Work on the systems may be reviewed at the point of manufacture a minimum of one time during fabrication. This review will occur during the final factory checkout prior to shipping, unless the Manufacturer and Architect agree on a more advantageous inspection date.

2.06 SUPPLEMENTARY

   A. Furnish equipment and hardware in addition to the items specified previously that are necessary to provide a fully working system in conformance with the intent of the Contract Documents.

PART 3 EXECUTION

3.01 EXAMINATION

   A. Examine work prepared by others to receive work of this Section and report defects affecting installation to the Architect for correction. Commencement of the work shall be construed as complete acceptance of preparatory work by others. The sphere of inspection includes but is not limited to:
      1. Assurance mounting surfaces are ready to accept the Work.
      2. Verification of flatness, plumb and level of mounting conditions.
      3. Inspection of components of the Work to ensure no damage has occurred during shipping or storage.

   B. Discrepancies:
      1. In the event of discrepancies, immediately notify the Architect.
2. Do not proceed with the installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 PREPARATION
   A. Verify field measurements at the site prior to installation and modify the system accordingly.
      1. Deliver equipment to the site only after the building has been closed in. Coordinate storage at the site and ensure the materials and components are undamaged.
      2. Protect the surrounding environment from damage by the Work.

3.03 FIELD QUALITY CONTROL
   A. Reviews:
      1. Final review will be made by the Architect or his appointed representative, following receipt in writing or notification from this Contractor that the installation is completed. If review reveals details of construction, fabrication, or installation not in strict accord with the Contract Documents, approval will be withheld and Contractor shall be given thirty days to replace the rejected items with those conforming to specification requirements. In addition to the final review of various equipment components the right of review is reserved during the course of the installation. The Architect or his appointed representative will be allowed access to materials at the site for eventual incorporation in the work. Preliminary visits shall not be construed as eliminating the possible rejection of various components during the final review detailed above.
      2. The completed installation of rigging equipment with draperies properly installed shall be tested and operated for the acceptance by the Architect by the Contractor prior to acceptance

END OF SECTION
PART 1 GENERAL

1.01 SUMMARY

A. The base system includes complete power and control systems serving:
   1. The Theatre
   2. The Studio Theatre
   3. The Recital Hall

B. Work in this section includes the engineering, manufacture, furnishing, coordination and installation of performance dimmers and control systems for the following purposes:
   1. Work Lighting
   2. House Lighting
   3. Performance Lighting

C. Section Includes
   1. Materials, components, modifications, assemblies, equipment and services as specified herein.
      These include, but are not limited to:
      a. Verification of site dimensions and conditions.
      b. Submittals as required by the Contract Documents.
      c. Engineering of equipment and systems as required by the Contract Documents.
      d. Manufacture of equipment and systems as required by the Contract Documents.
      e. Scheduling, sequencing and coordination with other trades.
      f. Site supervision of equipment and systems installation specified herein and elsewhere in the Contract Documents.
      g. Testing and demonstration of equipment and systems as specified herein and elsewhere in the Contract Documents.

D. Section Consists Of The following Subsystems
   1. Dimmer Racks With Phase Control Dimmers
   2. DMX Driven Motorized Breaker Panels
   3. Company Switches
   4. Emergency Lighting Transfer Switch
   5. Emergency DMX Transfer Switch
   7. Initial Programming
   8. Lighting Control Consoles & Peripherals
   9. Data Communications System
   10. Electronics Racks.
      a. Rack Panels
   11. Performance Lighting Circuit and Control Faceplates & Associated Cable Assemblies.
   12. Accessories.
   13. Data communications cable servicing control circuits connecting Performance Lighting Control faceplates specified herein to each other, to the dimmers specified herein and to the work lighting control system.

E. Products Furnished for installation by others.
   Unless otherwise noted installation will be by the Division 26 Contractor.
   1. Back boxes for faceplates. Gang backboxes, as outlined in the contract documents, are excepted from this and are provided under Division 26.
   2. Devices with 100v and above terminations including lighting receptacles, connector strips, faceplates and backboxes.
   3. Pipe mounted connector strip.
4. Busway power distribution.
5. Controlled motorized breaker panels.
7. Emergency Lighting Transfer Switch
8. Emergency DMX Transfer Switch (Wall Mounted)

F. Products Terminated Under This Section:
   1. Data Communications Cable.

1.02 RELATED DOCUMENTS
A. Division 1 Specification Sections apply to this Section.
   1. Where Division 1 and this section conflict the more stringent shall apply.
B. Base Building Documents, Division 26.

1.03 DEFINITIONS
A. The term “furnish” means to supply and deliver to the job site, ready for unloading, unpacking, assembly, installation, and similar operations.
B. The term “install” is used to describe operations at the job site including the actual anchoring, applying, assembly, cleaning, curing, cutting, erection, finishing, patching, placing, protecting, pulling, terminating, unloading, unpacking, working to dimension, and similar operations that will render the systems complete and ready for the intended use.
C. The term “provide” means to furnish and install.
D. The term "primary components" refer to elements of the system which Control levels, such as dimmers, and control console.
E. Dimmer Rack: A frame and chassis accommodating dimmer modules, load and line connections, and circuit protection.
F. Dimmer Rack Chassis: A cluster of dimmer modules with a common power supply.
G. Plug-In Module: A modular unit which is installed in a standardized mounting location throughout the dimmer rack.
H. Dimmer Module: A type of Plug-In Module containing one or more dimmers.
I. Data Communications: Signals that provide control and feedback communications between devices in the system.
K. Products utilizing the “ACN” control protocol shall comply with the rules and recommendations of the following standard: Entertainment Services & Technology Association (ESTA) ANSI E1.17 – 2006, Entertainment Technology - Architecture for Control Networks.
L. Products utilizing the “RDM” control protocol shall comply with the rules and recommendations of the following standard: Entertainment Services & Technology Association (ESTA) ANSI E1.20 – 2006, Entertainment Technology - RDM - Remote Device Management over USITT DMX512 Networks.
M. Products utilizing “Lightweight/Streaming ACN” control protocol shall comply with the rules and recommendations of the following standard: Entertainment Services & Technology Association (ESTA) ANSI E1.31 – 2009, Entertainment Technology – Lightweight streaming protocol for transport of DMX512 using ACN.
N. Products utilizing a “0 – 10V” control protocol shall comply with the rules and recommendations of the following standard: Entertainment Services & Technology Association (ESTA)ANSI E1.3 - 2001 (R2006), Entertainment Technology - Lighting Control Systems - 0 to 10V Analog Control Specification.
O. Products utilizing the DMX512 standard Entertainment Services & Technology Association (ESTA),
Transmission Standard for Controlling Lighting Equipment and Accessories shall comply with the rules
and recommendations of the following standard: ANSI E1.27-1-2006, Entertainment Technology-
Standard for Portable Control Cables for Use with USITT DMX512/1990 and E1.11 (DMX512-
A)Products.

P. Products utilizing the DMX512 standard Entertainment Services & Technology Association (ESTA),
Transmission Standard for Controlling Lighting Equipment and Accessories shall comply with the rules
and recommendations of the following standard: ANSI E1.27-2 – 2009, Entertainment Technology -
Recommended Practice for Permanently Installed Control Cables for Use with ANSI E1.11 (DMX512-
A) and USITT DMX512/1990 Products

Q. POE: Power Over Ethernet - an 802.3AF compliant scheme of powering devices on an Ethernet

R. Control Console: A Performance Lighting Control Console is capable of controlling stage lighting, house
lighting, and work lighting channels via ACN.

1.04 SYSTEM DESCRIPTIONS

A. Design Requirements
1. Standards and Regulations
   a. Components must comply with applicable regulations and ANSI Standards.
   b. Provide systems and components that are approved by an accredited independent testing
      laboratory such as Underwriters Laboratory.
   c. Equipment utilizing Stage Pin Connectors must comply with ANSI E1.24-2006.
   d. DMX equipment has ports able to communicate with any DMX compliant products.
   e. Ethernet systems are to be ACN compliant.
   f. Systems are to be RDM compliant.
   g. Controlled devices must comply with either DMX or ACN standards.

2. Emerging Standards:
   a. Systems must anticipate requirements of, comply with emerging standards.
   b. Systems must be compliant as much as is technologically possible at the time of the systems
      installation.
   c. Compliance will be evidenced by:
      1. The utilization of updatable code.
      2. Provision of basic enabling hardware.
      3. The absence of hardware or non-updatable software that will disable or interfere with the
         function of the emerging standard.

B. Performance Requirements
1. Key Switches
   a. Key switches do not interoperate with other equipment systems in the facility.

1.05 QUALIFICATIONS:

A. The Contractor shall have been authorized dealers or representatives of the manufacturers of the primary
   components for a minimum of two (2) years.
B. Where a manufacturer of a primary component offers factory training in the use of that component the
   Contractor is to have received that training.
C. The Contractor shall have been involved in Lighting Systems Contracting for Entertainment and Worship
   facilities for a period of five (5) years or more and shall have completed at least three (3) installations of
   this type and scope which have been in service for not less than two (2) years.
D. The Contractor shall provide, as part of their internal organization, the base system and not less than one (1) of the sub-systems specified. Additional Work in the Contract will be performed under their authority and responsibility as defined in the Contract Documents.

E. The Contractor shall maintain and operate shops for the integration and service of the system components.

F. The right is reserved to inspect previous equipment or systems as furnished or installed by this Contractor. In addition, the right is reserved to reject a Contractor who has failed in any respect to comply with the provisions of previous contracts.

G. No sub-contracting work is permissible, unless the Sub-Contractor is named and included as part of the bid. All terms and requirements herein apply to the Sub-Contractor. The right is reserved to reject the proposed Sub-Contractor based on the terms stated herein.

H. The Design Consultant shall be the final judge of suitability of experience.

I. Coordination with the electrical contractor and Work on site shall be supervised by an Entertainment Technician Certification Program (ETCP) Certified Electrician, or a licensee of authority having jurisdiction.

1.06 SUBMITTALS

A. Product Data

1. Submittal shall include manufacturer’s information sheets of equipment not explicitly specified by make and model that the contractor intends to provide as part of the project. Equipment matching make and model called out in the specification need not be submitted.

2. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings."

3. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:
   a. Manufacturer's printed recommendations.
   b. Compliance with recognized trade association standards.
   c. Compliance with recognized testing agency standards.
   d. Application of testing agency labels and seals.
   e. Notation of dimensions verified by field measurement.
   f. Notation of coordination requirements.
   g. Material Safety Data Sheets (MSDS) for each product.
   h. Catalog or data sheets indicating all component manufacturer's names, model numbers and performance data, where applicable.

B. Shop Drawings:

1. Submittals shall be in accordance with Division 1.

2. Shop drawings shall be submitted within 90 days of award of contract unless otherwise indicated in Division 1.

3. Fabrication, Installation, and Erection shall not commence until shop drawings have been approved by the Consultant and Architect.

4. Note and maintain one of the prints returned as a "Record Document".

5. Sheets in the submittal shall be of the same size.

6. Submittal shall include a title sheet listing sheets in the submittal.

7. Drawing scales:
   a. Mechanical Assembly Drawings (1/2"= 1'-0" minimum).
   b. Faceplate Fabrication Drawings (6" = 1'-0" minimum)
   c. Room layouts ( 1"=1'-0" minimum).
   d. Block schematics and riser diagrams. (NTS)
e. Miscellaneous Details and Assembly Drawings. (scale as necessary)
f. Mechanical Detail Drawings. (1"=1'-0" minimum).
g. Mechanical General Layout. (1/4"= 1'-0" minimum).
h. Component Equipment Drawings. (1"=1'-0" minimum).
i. Erection Plans and diagrams. (1/4"=1'-0" minimum).
j. Wiring Diagrams showing system layout (1/4"=1'-0" minimum).
k. System assemblies, major sub assemblies, components, cabinets and enclosures (1"=1'-0"
minimum).
l. Templates and installation details (1"-1'-0" minimum).

8. Highlight, encircle, or otherwise indicate deviations from the Contract Documents.
9. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings.
Standard information prepared without specific reference to the Project is not considered Shop
Drawings.
10. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns,
templates and similar drawings.
11. Lettering on Shop Drawings is considered part of the Drawings.
12. Show information necessary to explain fully the design features, appearance, function, fabrication,
installation, and use of system components in all phases of operation. Include the following
drawings as a minimum:
   a. Signal, control and power sequencing Block Diagrams detailing:
      1. Equipment
      2. Faceplates
      3. Interconnecting wires detailing the unique labels
      4. Terminating devices (Connectors or terminal strips)
      5. Where custom wiring is necessary detail each component (Switches, indicators, resistors,
power supplies, relays, etc)
      6. Multiconductor wiring
      7. Program logic and relationship to input / output points, either in logic diagrams or ladder
logic diagram, or other appropriate format.
   b. Faceplate & Rack Panel Fabrication Drawings detailing:
      1. Finishes
      2. Devices
      3. Engraving
   c. Mounting Details - where custom mounting systems are employed and as required by the
specifications
   d. Patch Panel Layouts detailing:
      1. Layout
      2. Labeling
      3. Normalling
   e. Rack Elevations detailing:
      1. Equipment location
      2. Equipment labeling
      3. Security covers
      4. Vent panels
      5. Fans
      6. Terminal points and their function
      7. Field wiring chases.
   f. Notation of coordination requirements.
   g. Notation of dimensions established by field measurement.
   h. Do NOT produce floorplans reiterating information already in the set, such as box layout and
low voltage conduit. These have been issued and form part of scope of work by others.
   i. DO review box layout and low voltage conduit drawings and note any areas of concern in a
Request for Information.
C. Coordination Drawings:
1. Coordination drawings are a special type of Shop Drawing that show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or function as intended.
   a. Preparation of coordination Drawings is specified in section "Project Coordination" and may include components previously shown in detail on Shop Drawings or Product Data.
   b. Submit coordination Drawings for integration of different construction elements. Show sequences and relationships of separate components to avoid conflicts in use of space.
2. Prepare and submit coordination Drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities.
3. Show the interrelationship of components shown on separate Shop Drawings.
4. Indicate required installation sequences.
5. Required Coordination Drawings include, but are not limited to:
   a. Diagrams detailing cable and wire installation for cable and wire supplied to and installed by others. These diagrams should indicate boxes and the quantity and type of wire and cable pulled between them.
   b. Dimmer room arrangement drawings.
   c. Installation instructions for equipment installed by others.

D. Record Document Submittals (As Built Drawings)
1. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistant location; provide access to record documents for the Architect's reference during normal working hours.
2. On completion of Work and prior to final review, neatly transfer as-built notations to set of transparencies, stamp drawings in set "Certified As-Built Drawings" and submit record documents to the Architect.
3. Record Documents: Maintain a clean, undamaged set of Contract Documents, Shop Drawings and Product Data. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that are concealed or cannot otherwise be readily discerned later by direct observation.
4. Include details on internal setting of components.
5. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.
6. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.
7. Note related Change Order numbers where applicable.
8. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
9. Testing Data - Include in record submittal documentation of performance tests as required in the contract documents.
10. Upon completion of the Work, submit Record Documents to the Architect for the Owner's records.
11. Record Sample Submitted: Immediately prior to the date or dates of Substantial Completion, the Contractor will meet at the site with the Architect and the Owner's personnel to determine which of the submitted Samples that have been maintained during progress of the Work are to be transmitted to the Owner for record purposes. Comply with delivery to the Owner's Sample storage area.
12. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Architect for the Owner's records.

E. Maintenance Manuals
1. Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 2-inch, 3-ring vinyl covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder.

2. Operating and Maintenance Instructions: Provide instruction manuals describing proper operation and maintenance. Include a detailed review of the following items:
   a. Cleaning.
   b. Control sequences.
   c. Copies of warranties.
   d. Emergency instructions.
   e. Fixture lamping schedule.
   f. Fuse list.
   g. Hazards.
   h. Identification systems.
   i. Inspection procedures.
   j. Lubricants.
   k. Maintenance and operation manuals.
   l. Recommended "turn around" cycles.
   m. Record documents.
   n. Shop Drawings and Product Data.
   o. Spare parts and materials.
   p. Spare parts list.
   q. Specifications for expendables.
   r. Tools.
   s. Warranties and bonds.
   t. Wiring diagrams reflecting actual labeling in the field.
   u. Maintenance agreements and similar continuing commitments.
   v. As Built drawings depicting actual locations and conditions of the system design, construction and arrangement.
   w. Equipment inventory with a listing for every item furnished or provided that includes the following information:
      1. Item
      2. Make
      3. Model
      4. Serial Number
      5. Firmware Version (where applicable)
      6. Quantity (>1 if there is no SN, IP, or MAC address)
      7. MAC Address (If IP Addressable)
      8. IP Address or "DHCP" (If IP Addressable)

3. As part of instruction for operating equipment, describe the following procedures:
   a. Start-up.
   b. Operation.
   c. Shutdown.
   d. Emergency operations.
   e. Noise and vibration adjustments.
   f. Safety procedures.
   g. Economy and efficiency adjustments.
   h. Effective energy use.
   i. Complete Subcontractor List including names and telephone numbers of persons to contact.

4. Provide four (4) copies of console manuals.

5. Provide three (3) sets of complete as built drawings.

6. Provide three (3) sets of maintenance manuals for the system.

7. Provide three (3) hard copies of initial system configuration.

8. Provide three (3) soft copies of initial system configuration.
9. Provide three (3) binders documenting the functions of presets, submasters, groups, crossfaders, and DMX universes on the lighting playback controllers.

F. The Architect's review of Submittals is only for general conformance with performance systems design concept of the project and general compliance with the Contract Documents.
   1. It is not a complete check on the method of assembly, engineering, erection or construction.
   2. Review shall in no way be construed as: permitting any departure whatsoever from the Contract Documents, except where the Contractor, in accordance with the provisions herein, has previously notified the Owner of, and the Owner has accepted, such departure; relieving the Contractor of full responsibility for any error in quality of materials, details, dimensions, omissions or otherwise that may exist; relieving the Contractor of full responsibility for adequate field connection, erection techniques, bracing or deficiencies in strength; relieving the Contractor of full responsibility for satisfactory performance of all work and contractors; or permitting departure from additional details or instructions previously furnished by the Architect.
   3. Review does not relieve the Contractor from the responsibility of errors in the Shop Drawings.
   4. This Contractor is responsible for: dimensions and measurements which shall be confirmed and correlated at the job site, correct quantities, materials, fabrication processes and techniques of construction and for the coordination of his work with other trades.

G. Resubmittals
   1. Make changes in the shop drawings as required, consistent with the Contract Documents. When resubmitting, notify the Consultant in writing of any revisions other than those required.
   2. Action indicated is subject to the requirements of the Contract Documents.
   3. Adjustments made on shop drawings are not intended to change the Contract Price. If adjustments affect the value of the Work, state such in writing prior to proceeding with the Work.

1.07 QUALITY ASSURANCE

A. Supplementary:
   1. Secure equipment, except portable equipment, firmly in place. Mount components rigidly, except where resilient isolation is required. Design and provide fastenings and supports adequate to support their loads with a safety factor of at least three.
   2. Clearly mark switches, jacks, outlets, cables, connectors, etc. logically and permanently during fabrication and installation.
   3. Where many cables are run in close proximity color code by function in a logical manner.
   4. Take necessary precautions to prevent and guard against electromagnetic, electrostatic and radio frequency interference.
   5. Provide control system wiring which is continuous from the faceplates to the racks. Employ no splices for entire cable length.
   6. Exercise care in wiring, so as to avoid damage to the cables and to the equipment. Between racks, cabinets, consoles or modules insure cables are well-supported, neatly laced and dressed. Make joints and connections with mechanical connectors approved by the Consultant.
   7. Group terminals by signal type.
   8. When cable is surface mounted and crossing through fire walls, use the equivalent Belden fire rated plenum cable to the specified cable type.
   9. Run power and high level circuits on one side of the racks or cabinets, as viewed from the rear. Run other circuits on the opposite side, as viewed from the rear.
  10. Label terminal strips, punch blocks, wire and cables in a permanent and logical manner with a unique number on each end of cable runs.
  11. Terminate all connections with rack with mating connectors, punch blocks, or terminal strips.
  12. Final location of equipment is as shown on the Drawings, located in the field by the Architect or as shown on supplementary drawings prepared by the Consultant.
1.08 SCHEDULES
A. Schedule and sequence the Work in conjunction and agreement with trades performing related, adjacent and intersecting work and the Construction Manager. Accommodate the Owner's projected time schedule for installation, particularly where coordination with other trades is required.
B. Submit preliminary progress schedule coordinated with Project construction schedule.
C. After review, revise and resubmit schedule to comply with revised project schedule.
D. During progress of Work, revise and resubmit schedules as pertinent events are recognized.

1.09 COORDINATION
A. Summary
   1. The Work involving performance equipment may be performed simultaneously to general building construction occurring on site. It is incumbent on this contractor to provide necessary coordination this Work and with adjacent and intersecting work, trades and facilities.
   2. This section describes administrative and supervisory requirements necessary for Project coordination including:
      a. Coordination.
      b. Administrative and supervisory personnel.
      c. General installation provisions.
B. Related areas of coordination are described elsewhere in the Contract Documents.
C. Coordinate included construction activities to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included in the Project that are dependent upon each other for proper installation, connection, and operation.
D. Where installation of one part of the Work is dependent on installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results.
E. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.
F. Make adequate provisions to accommodate items scheduled for later installation.
G. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination.
H. Include such items as required notices, reports, and attendance at meetings.
   1. Prepare similar memoranda for the Owner and separate Contractors where coordination of their Work is required.
I. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work.
J. Accurately cut, fit, drill and tap Work herein to accommodate and fit work of other trades. Furnish or obtain templates and drawings to or from applicable trades for proper coordination of this Work.
K. Coordinate the Work with related trades and the Construction Manager, this includes the preparation of schedules and coordination of equipment delivery, storage and installation.
L. Coordinate the system installation with the requirements of adjacent and intersecting Work.
M. Coordinate the following areas:
   1. Preparation of schedules.
   2. Installation and removal of temporary facilities.
   3. Delivery and processing of submittals.
   4. Progress meetings.
   5. Project Close-out activities.
1.10 AVAILABILITY

A. Immediately upon signing Contract, review Product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of products are foreseeable, notify the Architect of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in the performance of the Work.

B. In the event of failure to notify the Architect at commencement of the Work and should it subsequently appear that the Work may be delayed for such reasons, the Owner reserves the right to substitute more readily available products of similar character, at no increase in Contract Price.

1.11 WARRANTY

A. In addition to manufacturer's warranties, warrant systems and equipment to be free of defective components, faulty workmanship or improper adjustment for a period of two years from the date of Owner's acceptance. Paint and exterior finishes are excluded.

B. Replace items showing evidence of defective materials or workmanship (including installation workmanship) within thirty (30) days after notification. Make replacements without cost to the Owner.

C. Rectify conditions that might present a hazard to human life, well-being and or property within 48 hours of notification.

D. Included in warranty, and additional to the maintenance service is one visit scheduled to occur approximately thirty (30) days prior to expiration of this warranty. The contractor will contact the owner approximately sixty (60) days prior to the expiration of the warranty to arrange visits to be at a time mutually agreeable to the Owner and Contractor. During the visit the technician will thoroughly examine system components, including error logs and replace failing or failed components.

1.12 MAINTENANCE

A. Maintenance Service

1. Provide on-site maintenance service for a period of one year after final acceptance of the installation. This service shall cover the parts and labor resulting from correction of defects and/or improper installation of items specified in this section.

2. In addition to repair visits, this service consists of at least two half-yearly visits to the site for checking and adjusting of equipment. The first visit occurring six months after the system has been accepted. Arrange visits to be at a time mutually agreeable to the Owner and Contractor.

3. Provide 24 hour emergency service phone line. A field service engineer shall respond to an emergency call on this line within 30 minutes.

B. Extra Materials

1. Provide replacement spares as required and described herein.

1.13 PRODUCT HANDLING AND STORAGE

A. Items Furnished to Others for installation

1. The installing Contractor will make good or replace work, materials and equipment which have become contaminated, stolen, marred otherwise damaged, as directed by the Consultant and at no cost to the Owner once the equipment has been accepted by the installing Contractor.

2. Equipment will remain the responsibility of the installing Contractor until turned over to the owner.

B. All other items remain the responsibility of this Contractor until turned over to the owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Note that listing in this specification and its subsections does not relieve a manufacturer of compliance with the specified standards.

B. Note that listing in this specification and its subsections does not imply compliance with the specified standards.
C. A listed item found not to be in compliance with the specification will be rejected when the non-compliance is discovered.

2.02 SUPPLEMENTARY

A. Provide equipment and hardware in addition to the items specified previously that are necessary to provide a fully working system in conformance with the intent of the Contract Documents.

2.03 FABRICATION

A. Shop Assembly:
   1. Workmanship: Work shall be performed by an experienced fabricator or manufacturer and installed by experienced tradesmen. Materials, methods of fabrication, fitting, assembly, bracing, supporting, fastening, operating devices and erection shall be in accordance with the Contract Documents, reviewed shop drawings and best practices of the industry, using new and clean materials specified, having structural properties sufficient to safely sustain or withstand stresses and strains to which materials and assembled work will be subjected. Assemble, fabricate and erect all work in a neat and accurate fashion.
   2. Employ materials that are free of defects impairing strength, durability or appearance and of best commercial quality for the purpose specified. Employ materials with structural proportions to safely sustain and withstand stresses and strains to which they will be subjected. Fabricate true to detail, clean, straight with sharply defined profiles and, unless otherwise noted, with smooth finished surfaces.
   3. Supplementary Parts: Provide as necessary to complete each item of work, even in the event that such supplementary parts are not specifically mentioned in the Contract Documents.
   4. Connections:
      a. Make connections with tight joints, capable of developing full strength of the members and flush unless indicated otherwise. Locate joints where least conspicuous. Unless indicated otherwise, weld or bolt shop connections; bolt or screw field connections. Provide control joints as required to accommodate environmental variations.
      b. Employ fastening systems of appropriate sizes, ratings and quantities for the application. Where rated fasteners are employed, Provide domestically manufactured fasteners rated for anticipated loads and with approved markings indicating their rating. Provide fastener system's components of the same manufacture and equal ratings.
      c. Holes: Drill or cleanly punch holes, do not burn.
      d. In addition to all other requirements, install a hardened washer between bolt heads, nuts and materials having elongated holes.
      e. Unless specifically noted, and excepting graded, rated or otherwise certified fasteners, use nylon locking type nuts in locations subject to vibration and loosening.
      f. Unless otherwise noted, exposed bolt and screw heads shall be flat and countersunk.
   5. Insofar as practicable, perform fitting and assembly of the Work in the shop. Shop assemble the Work in the largest practical sizes to minimize field work. It is the responsibility of this Contractor to assure himself that shop fabricated items properly fit the field condition. In the event that shop fabricated items do not fit the field condition, return the item to the shop for correction.
   6. Cutting:
      a. Cut metal by sawing, shearing or blanking. Flame cutting is permitted only when edges are ground back to clean, smooth edges and no deformation or damage is caused to the metal by the process. Make cuts accurate, clean, sharp and free of burrs, without deforming adjacent surfaces or metals.
   7. Where dimensions and characteristics have been omitted, furnish based on criteria setforth herein.
PART 3 EXECUTION

3.01 SITE CONDITIONS
A. Sequence delivery and installation of components to protect their long term viability. Of particular concern is protecting electronic contacts from abrasive construction dust and grit and protecting devices from the accumulation of dust which can lead to early component failure.
B. If devices must be installed prior to the room being clean, dry and dust free protect connectors and internal components from the infiltration of dust and thoroughly clean the components of all dust and grit before beginning testing. Devices with evidence of abrasion on the contacts will be rejected.
C. Devices not installed but required for testing are to be brought to the site for in time for testing.
D. Devices not required for testing are to be delivered at the first training session.

3.02 INSTALLATION
A. Provide racks, furniture, consoles, etc., required for the installation and needed to provide completed systems. Only to the extent that such ancillary equipment is specified elsewhere is it excluded from these system Specifications.
B. Provide low voltage cable.
C. Terminate and install low voltage faceplates.
D. Terminate control lines.
E. Interface:
   1. Coordinate work with the Division 26 Contractor in accordance with the contract documents.
   2. Contract documents are diagrammatic and indicate general arrangement of systems and work included.
   3. Follow drawings in laying out work and check drawings of other trades relating to work to verify spaces in which work is installed.
   4. Maintain headroom and space conditions at all points.

3.03 DELIVERY
A. Materials within this contract will be delivered by the contractor to the project site.
B. Equipment furnished under Division 11 61 61 will become the responsibility of the Division 26 Contractor at such time that the Division 26 Contractor takes possession of the equipment from the 11 61 61 contractor.
   1. At this time the Division 26 Contractor will document the exact condition, breakage or damage evident in the equipment.
   2. Exact quantities will be documented.
   3. Discrepancies in the quantities and damage or unsuitability of the product for the application will be provided in writing to the 11 61 61 contractor upon transfer of the equipment.
   4. Acceptance of the equipment verifies proper physical condition of the product. Electrical functionality is not implied at acceptance and is not the responsibility of the Division 26 Contractor.
   5. The 11 61 61 Contractor will be present at the time of transfer to coordinate and expedite this action. The 11 61 61 Contractor shall be given a two week minimum lead time prior to this meeting.

3.04 SUPERVISION OF INSTALLATION
A. Provide instruction and supervision to the Division 26 Contractor as it pertains to the installation of these systems. Provide the necessary personnel for coordination meetings and site visits prior to installation of systems.

3.05 FIELD QUALITY CONTROL
A. Tests - Perform tests to ensure the following criteria and provide certification:
1. Labeling of faceplates has correct correlation of dimmer number and faceplate circuit number.
2. Polarity of circuits is correct.
3. Test voltage drop at each end of circuits with a 2Kw load and record voltage.
4. DMX and Ethernet lines for throughput, packet formation, termination, and noise.
5. Pairing of circuits is correct.

B. If final acceptance is delayed beyond two test days or visits because the system does not fulfill this specification, pay for time and expenses of the Architect’s Consultant during any extensions of the acceptance testing period.

3.06 DEMONSTRATION & INSTRUCTION
A. Create an initial configuration for test purposes which demonstrates the full capabilities of the system, demonstrates how it meets specification, and demonstrates areas in which it exceeds specification.
B. Provide Training on this equipment system to be scheduled at times mutually agreed upon with the owner. This training time is to be divided into the following sessions as a minimum:
   1. Initial training
   2. Follow-up training.
   3. Attendance at the first cueing session.

3.07 PROJECT CREDIT
A. In publications where this project is mentioned give credit to:
   1. The Design Architect
   2. Theatre Consultant: Theatre Consultant’s Collaborative, Inc

3.08 SCHEDULES
A. System Drawings
B. Construction Drawings

END OF SECTION
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PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Horizontal slat louver blinds.
   B. Operating hardware.

1.02 RELATED REQUIREMENTS
   A. Section 06.10.00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.03 REFERENCE STANDARDS

1.04 ADMINISTRATIVE REQUIREMENTS
   A. Coordinate the placement of concealed blocking to support blinds. See Section 06.10.00.

1.05 SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide data indicating physical and dimensional characteristics.
   C. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.
   D. Samples: Submit two samples, 6 inch long illustrating slat materials and finish, cord type and color.
   E. Manufacturer's Installation Instructions: Indicate special procedures.
   F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
      1. Extra Blind Assemblies: One of each size.
      2. Extra Slats: 20 of each type and size.
      3. Extra Lift Cords, Control Cords, and Wands: One of each type.

1.06 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 BLINDS WITHOUT SIDE GUIDES
   A. Description: Horizontal slat louvers hung from full-width headrail with full-width bottom rail.
   B. Manual Operation: Control of raising and lowering by cord with full range locking; blade angle adjustable by control wand.
   C. Metal Slats: Spring tempered pre-finished aluminum; square slat corners, with manufacturing burrs removed.
      1. Width: 2 inch.
      2. Thickness: 0.008 inch.
   D. Slat Support: braided polyester yarn, ladder configuration.
   E. Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats.
F. Headrail Attachment: Wall brackets.

2.02 FABRICATION
   A. Determine sizes by field measurement.
   B. Fabricate blinds to cover window frames completely.
   C. At openings requiring multiple blind units, provide separate blind assemblies with space of 1/4 inch between blinds, located at window mullion centers.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that openings are ready to receive the work.
   B. Ensure structural blocking and supports are correctly placed. See Section 06.10.00.

3.02 INSTALLATION
   A. Install blinds in accordance with manufacturer's instructions.
   B. Secure in place with flush countersunk fasteners.

3.03 TOLERANCES
   A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch.
   B. Maximum Offset From Level: 1/8 inch.

3.04 ADJUSTING
   A. Adjust blinds for smooth operation.

3.05 CLEANING
   A. Clean blind surfaces just prior to occupancy.

END OF SECTION 12.21.13
SECTION 12.22.16
DRAPERY TRACK AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Formed steel track.
   B. Nylon carriers, cords, and accessories.
   C. Motorized carrier device.

1.02 REFERENCE STANDARDS
   A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
   B. WCMA A100.1 - Safety of Corded Window Covering Products; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS
   A. Coordinate location and installation of concealed blocking for support of tracks.

1.04 SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide track profiles, acceptable load data, finishes available, and electrical characteristics and connection requirements.
   C. Shop Drawings: Indicate end track location, width of window opening, location of blocking for anchors, appurtenances and interferences, adjacent construction, operating hardware, and support bracket details.
   D. Manufacturer's Installation Instructions: Indicate procedures, perimeter conditions requiring attention.
   E. Maintenance Data: Include data for motor, shaft and gearing, lubrication frequency, control adjustments, spare part sources.
   F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
      1. Extra Carriers: Quantity equal to 5 percent of those installed.
      2. Extra Control Cords/Wands: Two of each type installed.

1.05 QUALITY ASSURANCE
   A. Manufacturer: Company specializing in manufacturing the products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 COMPONENTS
   A. Tracks: Formed steel, bi-parting operating traverse rods, heavy duty channel track.
   B. Track Brackets: Formed steel wall type, for recessed installation, with screws and inserts for attachment.
   C. Carriers: Nylon roller 3 per foot.
   D. Cord: Braided nylon; continuous loop, free end weighted, complying with WCMA A100.1.
   E. Control Wand: Extruded hollow plastic; square shape; non-removable type; length of window opening height less 3 inches.
2.02 ELECTRICAL CHARACTERISTICS AND COMPONENTS
   A. Control Station: Three button, open-close-stop, momentary type, control for each electric operator; surface mounted, switch located at Location to be determined.
   B. Electric Operator: Center mounted, adjustable friction clutch, enclosed limit switch; mounting brackets and hardware; manually operable in case of power failure; transit time of 8 inches per second.
   C. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
   D. Disconnect Switch: Factory mount disconnect switch in control panel.

2.03 FINISHES
   A. Exposed Surfaces: Baked enamel, color to be selected.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Verify that concealed anchors are in correct position.
   B. Verify that electrical service is correctly located and of proper characteristics.

3.02 INSTALLATION
   A. Install drapery tracks in accordance with manufacturer's instructions.
   B. Mount track and motor support brackets on solid backing. Where mounting location does not align with solid backing, provide expanding anchors for each screw hole location.
   C. Anchor tension pulley to wall.
   D. Set cord pulls so that cord pull is 12 inches below window sill in full open position.

3.03 ADJUSTING
   A. Adjust drapery hardware for smooth operation.

END OF SECTION 12.22.16
PART 1 GENERAL

1.01 SECTION INCLUDES

A. Window shades and accessories.
B. Electric motor operators.
C. Motor controls.

1.02 RELATED REQUIREMENTS

A. Section 06.10.00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.
B. Section 09.21.16 - Gypsum Board Assemblies: Substrate for window shade systems.
C. Section 09.51.00 - Suspended Acoustical Ceilings: Shade Pockets, pocket closures and accessories.

1.03 REFERENCE STANDARDS

D. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Where motorized shades are to be controlled by control systems provided under other sections, coordinate the work with other trades to provide compatible products.
   2. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.
B. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of all affected installers.
C. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken.
   2. Do not install shades until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
   1. Motorized Shades: Include power requirements and standard wiring diagrams.
C. Shop Drawings: Include shade schedule indicating size, location and keys to details.
D. Shop Drawings - Motorized Shades: Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.
E. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.
F. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.
G. Selection Samples: Include fabric samples in full range of available colors and patterns.
   1. Motorized Shades: Include finish selections for controls.

H. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

I. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.

J. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

K. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

L. Maintenance contracts.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of this type with minimum _____ years of documented experience.
   1. Factory training and demonstrated experience.

1.07 MOCK-UP

A. Mock-Up: Provide full size mock-up of window shade complete with selected shade fabric including sample of seam when applicable.
   1. Obtain Architect's approval of light and privacy characteristics of fabric prior to fabrication.
   2. Full-sized mock-up may become part of the final installation.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.09 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 WARRANTY

A. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
   1. Shade Hardware: One year.
   2. Electric Motors: One year.

PART 2 PRODUCTS

2.01 WINDOW SHADE APPLICATIONS

A. Shades: Sheer shades.
   1. Type: Roller shades.
   2. Fabric Performance Requirements:
      a. Openness Factor: 5 %minimum.
   3. Color: As selected by Interior Designer from manufacturer’s full range of colors.
2.02 ROLLER SHADES

A. Roller Shades: Fabric roller shades complete with mounting brackets, roller tubes, hembars, hardware and accessories; fully factory-assembled.
   1. Drop: Regular roll.
   2. Size: As indicated on drawings.

B. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Sheer Shades: Reduce glare yet still reveal considerable details to the outside; no privacy; Openness Factor minimum of 5 percent.
   2. Flammability: Pass NFPA 701 large and small tests.
   3. Fungal Resistance: No growth when tested according to ASTM G21.

C. Roller Tube: As required for type of operation, extruded aluminum with end caps.
   1. Dimensions: Manufacturer's standard, selected for suitability for installation conditions, span, and weight of shades.
   2. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.

D. Hembars and Hembar Pockets: Wall thickness designed for weight requirements and adaptation to uneven surfaces, to maintain bottom of shade straight and flat.

E. Manual Operation: Clutch operated continuous loop; beaded ball chain.

F. Motor Operation: Motor system housed inside roller tube, controlling shade movement via motor controls indicated; listed to UL 325.
   1. Audible Noise: Maximum 39 dBA measured 3 feet from the motor unit; no audible clicks when motor starts and stops.
   2. Motors: Size and configuration as recommended by manufacturer for the type, size, and arrangement of shades to be operated; integrated into shade operating components and concealed from view.
   3. Motor Type: Both AC and DC motors are acceptable; provide required transformers for DC motors.
   4. Coupling of Multiple Shades: Where possible, minimize number of motors by coupling adjacent shades.
   5. Control Compatibility: Fully compatible with the controls to be installed.

2.03 MOTOR CONTROLS

A. Motorized shades to be controlled by wall-mounted controls and infrared handheld remote controls as specified below.

B. Control Requirements:
   1. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated.
   2. Capable of controlling shade speed for tracking within plus or minus 0.125 inch throughout entire travel.
   3. Capable of stopping within accuracy of 0.125 inch at any point between open and close limits.
   4. Capable of assigning shades to groups and subgroups without rewiring.
   5. Provide 10 year power failure memory for preset stops, open and close limits, shade grouping and subgrouping and system configuration.
   6. Capable of synchronizing multiple units of the same size to start, stop and move in unison.
   7. Provide all components and connections necessary to interface with other systems as indicated.

C. Wall-Mounted Controls: UV stabilized visible parts meeting ASTM D4674; furnished with backlit buttons; provided by shade manufacturer.
   1. Control Functions:
a. Open: Automatically open controlled shade(s) to fully open position when button is pressed.
b. Close: Automatically close controlled shade(s) to fully closed position when button is pressed.
c. Raise: Raise controlled shade(s) only while button is pressed.
d. Lower: Lower controlled shade(s) only while button is pressed.
e. Stop shade(s) in motion by tap on any button.
2. Button Engraving: Manufacturer's standard engraving, unless otherwise indicated.

D. Infrared Handheld Remote Control: Battery-powered; provided by shade manufacturer.
   1. Control Functions:
      a. Open: Automatically open controlled shade(s) to fully open position when button is pressed.
      b. Close: Automatically close controlled shade(s) to fully closed position when button is pressed.
      c. Raise: Raise controlled shade(s) only while button is pressed.
      d. Lower: Lower controlled shade(s) only while button is pressed.
      e. Stop shade(s) in motion by tap on any button.

2.04 ACCESSORIES
   A. Fascias: Size as required to conceal shade mounting.
      1. Style: As selected by Architect from shade manufacturer's full selection.
      2. Material and Color: To match shade.
   B. Brackets and Mounting Hardware: As recommended by manufacturer for mounting configuration and span indicated.
   C. Fasteners: Non-corrosive, and as recommended by shade manufacturer.

2.05 FABRICATION
   A. Field measure finished openings prior to ordering or fabrication.
   B. Fabricate shades to fit openings within specified tolerances.
      1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
   C. Dimensional Tolerances: As recommended in writing by manufacturer.
   D. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Examine finished openings for deficiencies that may preclude satisfactory installation.
   B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
   C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION
   A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
   B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION
   A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
B. Installation Tolerances:
   1. Inside Mounting: Maximum space between shade and jamb when closed of 1/16 inch.

C. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.

D. Adjust level, projection and shade centering from mounting bracket. Verify there is no telescoping of
   shade fabric. Ensure smooth shade operation.

3.04 SYSTEM STARTUP
   A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform
      system startup.

3.05 CLEANING
   A. Clean soiled shades and exposed components as recommended by manufacturer.
   B. Replace shades that cannot be cleaned to "like new" condition.

3.06 CLOSEOUT ACTIVITIES
   A. See Section 01.78.21 - Closeout Submittals, for closeout submittals.
   B. See Section 01.79.21 - Demonstration and Training, for additional requirements.
   C. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.
   D. Training: Train Owner's personnel on operation and maintenance of system.
      1. Use operation and maintenance manual as training reference, supplemented with additional training
         materials as required.
      2. Provide minimum of two hours training by manufacturer's authorized personnel at location
         designated by the Owner.

3.07 PROTECTION
   A. Protect installed products from subsequent construction operations.
   B. Touch-up, repair or replace damaged products before Substantial Completion.

3.08 MAINTENANCE

END OF SECTION 12.24.00
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Kitchen cabinets.
   B. Vanity cabinets.
   C. Casework hardware.

1.02 RELATED REQUIREMENTS
   A. Section 07.92.00 - Joint Sealants: Sealing joints between casework and countertops and adjacent walls, floors, and ceilings.
   B. Section 12.36.00 - Countertops.

1.03 REFERENCE STANDARDS
   B. KCMA (DIR) - Directory of Certified Cabinet Manufacturers; current edition, online.

1.04 SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Provide component dimensions and construction details.
   C. Shop Drawings: Indicate casework locations, large scale plans, elevations, clearances required, rough-in and anchor placement dimensions and tolerances.

1.05 QUALITY ASSURANCE
   A. Products: Complying with KCMA A161.1 and KCMA Certified.
   B. Manufacturer: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 COMPONENTS
   A. Cabinet Construction: Softwood lumber framing and particle board.
   B. Countertops: As specified in Section 12.36.00.
   C. Door and Drawer Fronts: Plastic laminate over particle board.

2.02 HARDWARE
   A. Hardware: Manufacturer's standard.
   B. Drawer and Door Pulls: Chrome wire pulls, 4 inches wide.
   C. Sliding Door Pulls: Recessed steel circular design.
   D. Catches: Magnetic.
   E. Drawer Slides: Extension arms, steel and ball bearing construction.
   F. Hinges: Offset pin.
   G. Sliding Door Track Assemblies: Nylon track with roller bearing followers.
2.03 FABRICATION
A. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
B. Fabricate corners and joints without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
C. Fabricate each unit to be rigid and not dependent on building structure for rigidity.
D. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
E. Provide cutouts for plumbing fixtures, appliances, and fixtures and fittings. Prime paint contact surfaces of cut edges.
F. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

2.04 FINISHES
A. Exposed To View Surfaces: Plastic laminate, color as selected.

PART 3 EXECUTION

3.01 EXAMINATION
A. Verify adequacy of support framing.

3.02 INSTALLATION
A. Install casework, components and accessories in accordance with manufacturer's instructions.
B. Use anchoring devices to suit conditions and substrate materials encountered.
C. Set casework items plumb and square, securely anchored to building structure.
D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Use filler strips; not additional overlay trim for this purpose.
E. Close ends of units, back splashes, shelves and bases.

3.03 ADJUSTING
A. Adjust doors, drawers, hardware, fixtures, and other moving or operating parts to function smoothly.

3.04 CLEANING
A. Clean casework, countertops, shelves, and hardware.

3.05 PROTECTION
A. Do not permit finished casework to be exposed to continued construction activity.

END OF SECTION 12.35.30
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Countertops for architectural cabinet work.
   B. Countertops for manufactured casework.
   C. Wall-hung counters and vanity tops.

1.02 RELATED REQUIREMENTS
   A. Section 06.41.00 - Architectural Wood Casework.
   B. Section 12.35.30 - Residential Casework.

1.03 REFERENCE STANDARDS
   C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
   E. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.
   G. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for 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. Specimen warranty.
   C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.
   D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
   E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
   F. Installation Instructions: Manufacturer's installation instructions and recommendations.
   G. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE
   A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING
   A. Store products in manufacturer's unopened packaging until ready for installation.
   B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
1.07 FIELD 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.

PART 2 PRODUCTS

2.01 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
   1. Laminate Sheet, Unless Otherwise Indicated: NEMA LD 3, Grade HGF, fire retardant rated, 0.048 inch nominal thickness.
      a. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      b. NSF approved for food contact.
      c. Wear Resistance: In addition to specified grade, comply with NEMA LD 3 High Wear Grade requirements for wear resistance.
      d. Finish: Matte or suede, gloss rating of 5 to 20.
      e. Surface Color and Pattern: As selected by Architect from the manufacturer's full line.
   2. Exposed Edge Treatment: Square, substrate built up to minimum 1-1/4 inch thick; covered with matching laminate.
   3. Back and End Splashes: Same material, same construction.
   4. Fabricate in accordance with AWI/AWMAC/WI (AWS), Section 11 - Countertops, Custom Grade.

C. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
   1. Flat Sheet Thickness: 1-1/4 inch, minimum.
   2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with the MIA Dimension Stone Design Manual.
      b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      c. NSF approved for food contact.
      d. Finish on Exposed Surfaces: Polished.
   3. Wall Panels: 3/4 inch thick.
   4. Other Components Thickness: 3/4 inch, minimum.
   5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

2.02 MATERIALS

A. Wood-Based Components:
   1. Wood fabricated from old growth timber is not permitted.

B. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2

C. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

D. Joint Sealant: Mildew-resistant silicone sealant, white.
2.03 FABRICATION
A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
   3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Height: 4 inches, unless otherwise indicated.
C. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

PART 3 EXECUTION

3.01 EXAMINATION
A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 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.

3.03 INSTALLATION
A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.
C. Attach epoxy resin countertops using compatible adhesive.
D. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES
A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.
B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
C. Field Joints: 1/8 inch wide, maximum.

3.05 CLEANING
A. Clean countertops surfaces thoroughly.

3.06 PROTECTION
A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 12.36.00
PART 1  GENERAL

1.01  SECTION INCLUDES
   A. Fixed, upholstered theater chairs.
   B. Support standards.
   C. Chair accessories.

1.02  RELATED REQUIREMENTS

1.03  REFERENCE STANDARDS

1.04  ADMINISTRATIVE REQUIREMENTS
   A. Coordination with Electrical Work: Coordinate installation of wiring to ensure that floor-mounted junction boxes are completely beneath seats and free of aisle spaces.

1.05  SUBMITTALS
   A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
   B. Product Data: Manufacturer's printed data sheets for products specified.
   C. Shop Drawings: Fabrication and installation details, chair layouts and dimensions and seat numbering scheme.
      1. Field Measurements: Verify seating layout by field measurements and record field dimensions on shop drawings.
   D. Selection Samples: Manufacturer's color charts and swatches for fabric upholstery, indicating full range of materials, colors, and patterns available.
   E. Verification Samples: Full-size two-seat fabricated sample of each type of chair specified, including all accessories and one end panel, illustrating all finishes and workmanship to be expected in the finished Work; approved sample may be incorporated into the Work.

1.06  QUALITY ASSURANCE
   A. Installer Qualifications: An experienced installer certified in writing by the seating manufacturer to be qualified for installation of specified seating.
   B. Fire Retardance of Upholstered Seating: Self-extinguishing when mock-up is exposed to smoldering cigarettes in accordance with ASTM E1352 or NFPA 261.
C. Fire Retardance of Fixed Theater Seating: Maximum instantaneous net peak rate of heat release of 250 kW or less, and total energy released during first 5 minutes of 40 mJ or less, when tested in accordance with ASTM E1537.

1.07 DELIVERY, STORAGE, AND HANDLING
   A. Deliver seats to project site in unopened containers clearly labeled with manufacturer's name and identification of contents.
   B. Store seating units in dry and clean location until needed for installation. During installation, handle in a manner that will prevent marring and soiling of finished surfaces.

PART 2 PRODUCTS

2.01 MATERIALS
   A. Cast Iron: ASTM A48/A48M, Class 25A minimum, free of air holes and casting imperfections, all edges ground smooth.
   B. Sheet Steel: ASTM A879/A879M, Commercial Steel (CS) or Drawing Steel (DS) electrogalvanized sheet, 04Z (12G) coating class on both surfaces; chemically treated for baked enamel finish.
   C. Exposed Hardwood: Solid lumber selected for absence of visible defects; birch, northern hard maple, white oak, or species standard with manufacturer.
   D. Hardwood Plywood: HPVA HP-1; face veneers for exposed surfaces Grade A birch, hard maple, walnut, or as standard with manufacturer, with no visible defects; concealed surface veneers of sound grade hardwood.
   E. Polyurethane Foam: Density not less than 1.8 lb/cu ft, fire retardant, non-hardening and non-oxidizing, with high resistance to alkalis, oils, moisture, and mildew.

2.02 UPHOLSTERED CHAIRS
   A. Fixed seating system designed to permit radial installation using common middle support standards in each row and aisle standards aligned as indicated on drawings. Width of seats not less than 22 inches, except exit seat locations may be reduced to 20 inches to complete specific row dimensions.
   B. Backs: Fixed type; two-panel construction with fabric covering over padding and protective back panel, with installed height not less than 32 inches above finished floor.
      1. Padding: Polyurethane foam not less than 4 in thick bonded to structural support.
      2. Covering: Fabric bonded to padding and fastened by upholstery technique that facilitates replacement.
      3. Rear Panel: One-piece molded plywood, not less than 1/4 in thick, with exposed back surface of hardwood face veneer.
   C. Seats: Hinged type, constructed to permit reupholstering without removing seat from chair.
      1. Steel Seat Construction: One-piece sheet steel pan construction, reinforced at stress points; supporting not fewer than 16 coil springs or five non-sag serpentine springs. Separate padding from springs with burlap sheeting cemented to polyurethane foam padding formed with minimum thickness of 1-3/4 in. Upholster with fabric sewn into box construction without welts and securely fastened to supporting frame to provide smooth, wrinkle-free surface.
         a. For serpentine spring construction, provide not less than 4 in thick foam padding at front edge of seat.
         b. Perforate steel seat pan and provide interior acoustic baffle for sound absorption when seat is in raised position.
   D. Hinges: Self-lubricating, noiseless steel hinges with brass alloy bearings or nylon bushings, equipped with spring mechanism that causes unoccupied seat to rise automatically to uniform 3/4 fold, with 100 percent fold when additional pressure is applied.
E. Arm Rests: Locate at aisles and between chairs; mount to support standard with concealed fasteners; exposed surfaces of solid hardwood lumber with smoothed edges.

F. End Panels: One piece panels fastened securely to aisle standards with concealed fasteners, configured as follows:
   1. Shape: Tapered.
   2. Finish: Solid hardwood.

2.03 STANDARDS
A. Support Standards: Sheet steel with formed edges and end panels with welded mounting points for backs, seats, and arm rests, and welded floor anchor plates.

2.04 ACCESSORIES
A. Aisle Lights: Manufacturer's standard UL-approved concealed lamp assemblies, with louvers to conceal lamp and direct light toward floor, mounted beneath aisle arm rest; wiring route concealed to floor connection.

2.05 FINISHES
A. Ferrous Metals: Manufacturer's standard two-coat baked enamel finish, applied over conversion coating appropriate to base metal.
   1. Color and Gloss: As selected from manufacturer's standard choices.
B. Hardwood: Manufacturer's standard clear low-gloss finish.
C. Hardwood Plywood: Manufacturer's standard clear low-gloss finish.

PART 3 EXECUTION

3.01 EXAMINATION
A. Examine substrates for conditions detrimental to installation of fixed theater seating. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION
A. Comply with manufacturer's installation instructions and approved shop drawings.
B. Anchor support standards securely to substrate with at least two anchoring devices recommended by manufacturer.
   1. Place standards in each row laterally so the standards at the aisle will be in alignment.
   2. Vary width of seats and backs as required to optimize sightlines, and comply with the ADA Standards for row and aisle widths.
   3. Attach components to standards with sufficient flexibility to compensate for convergence of seats toward the center.

3.03 ADJUSTING
A. Adjust seat mechanisms to ensure that seats in each row are aligned when unoccupied.
B. Repair minor abrasions and imperfections in painted finishes with a coating that matches factory-applied finish; replace units that cannot be repaired to unblemished appearance.
C. Replace upholstery fabric damaged or soiled during installation.

END OF SECTION 12.61.00
PART 1 GENERAL

1.01 SECTION INCLUDES
A. Benches.
B. Bollards.
C. Planters.
D. Waste receptacles.
E. Skate deterrents.

1.02 RELATED REQUIREMENTS
A. Section 03.30.00 - Cast-in-Place Concrete: Bollard infill and underground encasement.
B. Section 05.50.00 - Metal Fabrications: Anchors to attach site furnishings to mounting surfaces.

1.03 REFERENCE STANDARDS
C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

1.04 SUBMITTALS
A. See Section 01.30.00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer’s specifications and descriptive literature, installation instructions, and maintenance information.
C. Shop Drawings: Indicate plans for each unit or groups of units, elevations with model number, overall dimensions; construction, and anchorage details.

1.05 WARRANTY
A. Provide manufacturer’s warranty against defects in materials or workmanship for ductile iron castings for a period of 10 years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 METAL FURNISHINGS
A. Metal Furnishings, General:
   1. Cast iron components: Ductile iron castings complying with ASTM A536; cleaned, treated, and powder-coated.
   2. Steel components: Plates, bars, and shapes complying with ASTM A36/A36M and tubing complying with ASTM A500/A500M; cleaned, treated, and powder-coated.
B. Benches: Metal frame and seat section with back and armrests.
1. Frame: Steel.
2. Seat: Steel slat.
3. Products:
   a. SiteScapes, Inc; CityView: www.sitescapesonline.com.

C. Planters: Steel frame with steel slats.
   1. Shape: Round.
   2. Products:
      a. SiteScapes, Inc; CityView Planters - Flair Top: www.sitescapesonline.com.

D. Table Sets: Metal frame and seat section as indicated.
   1. Frame: Steel.
   2. Seat: Steel slat.
   3. Products:
      a. SiteScapes, Inc; CityView: www.sitescapesonline.com.

E. Bike Rack: Metal frame.
   1. Manufacturer: Dero Bike racks: www.dero.com
   2. Color: Black

F. Recycling Containers:
   1. Products: SiteScapes, Inc.; CityView Vertical Strap REceptavles Top Opening: www.sitescapesonline.com
   2. Provide special use lids with custom configured disposal slots prefer for bottles, cans, or newspaper.

G. Waste Receptacles: Steel frame with steel slats and removable lid.
   2. Shape: Round.
   4. Products:
      a. SiteScapes, Inc; CityView Vertical Strap Receptacles Side Door: www.sitescapesonline.com.

2.02 BOLLARDS
A. Steel Pipe Bollards: Hollow steel pipe with plain shaft.
   1. Materials:
      c. Color: As selected by Architect from manufacturer’s standard range.
   2. Mounting: In-ground.

2.03 SKATE DETERRENTS
A. Skate Deterrents:
   1. Material: Stainless Steel; ASTM A666 Type 316, No. 4 finish.
   2. Attachment: Surface mounted to benches, planters, tables, and table seating.
   3. Anchoring: Tamper-resistant screws, pins or bolts as recommended by manufacturer.

PART 3 EXECUTION
3.01 EXAMINATION
A. Verify that mounting surfaces, preinstalled anchor bolts, or other mounting devices are properly installed; and ready to receive site furnishing items.
B. See Section 05.50.00 for anchors to attach site furnishings to mounting surfaces.
C. Do not begin installation until unacceptable conditions are corrected.

3.02 INSTALLATION

A. Install site furnishings in accordance with approved shop drawings, and manufacturer’s installation instructions.

B. See Section 03.30.00 for bollard infill and underground encasement.

C. Provide level mounting surfaces for site furnishing items.

END OF SECTION 12.93.00
100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
SECTION 14.21.00
ELECTRIC TRACTION ELEVATORS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Complete electric traction elevator systems.
   1. Passenger type.
B. Elevator Maintenance Contract.

1.02 RELATED REQUIREMENTS
A. Section 04.20.00 - Unit Masonry: Masonry hoistway enclosure; building-in and grouting hoistway door frames.
B. Section 09.21.16 - Gypsum Board Assemblies: Gypsum shaft walls.
C. Section 09.68.00 - Carpeting: Floor finish in car.

1.03 REFERENCE STANDARDS
K. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
R. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
S. NEMA MG 1 - Motors and Generators; 2014.
T. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
V. PS 1 - Structural Plywood; 2009.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate work with other installers to provide necessary conduits for proper installation of wiring, including but not limited to, the following:
   2. Coordinate work with other installers for equipment provisions necessary for proper elevator operation, including but not limited to, the following:
      a. Automatic transfer switches with auxiliary contacts for emergency power transfer status indication.
      b. Shunt trip devices for automatic disconnection of elevator power prior to fire suppression system activation; include provisions for shunt trip power monitoring.
      c. Overcurrent protection devices selected to achieve required selective coordination.

B. Preinstallation Meeting: Convene meeting at least one week prior to start of this work.
   1. Review schedule of installation, proper procedures and conditions, and coordination with related work.

C. Construction Use of Elevator: Not permitted.

1.05 SUBMITTALS

A. Product Data: Submit data on following items:
   1. Signal and operating fixtures, operating panels, and indicators.
   2. Car design, dimensions, layout, and components.
   3. Car and hoistway door and frame details.
   4. Electrical characteristics and connection requirements.

B. Shop Drawings: Submit drawings and details on following items:
   1. Elevator Equipment and Machines: Size and location of driving machines, power units, controllers, governors, and other components.
   2. Hoistway Components: Size and location of car machine beams, guide rails, buffers, ropes, and other components.
   3. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
   4. Clearances and over-travel of car and counterweight.
   5. Locations in hoistway and machine room of traveling cables and connections for car lighting and telephone.
   6. Location and sizes of hoistway and car doors and frames.
   7. Applicable seismic design data; certified by a licensed Professional Structural Engineer.
   8. Electrical characteristics and connection requirements.
   9. Indicate arrangement of elevator equipment and allow for clear passage of equipment through access openings.

C. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

D. Initial Maintenance Contract.

E. Maintenance Contract: Submit proposal to Owner for standard one year continuing maintenance contract agreement in accordance with ASME A17.1 and requirements as indicated, starting on date initial maintenance contract is scheduled to expire.
   1. Indicate in proposal the services, obligations, conditions, and terms for agreement period and for renewal options.
1.06 QUALITY ASSURANCE
A. Maintain one copy of each quality standard document on site.
B. Designer Qualifications: Perform design under direct supervision of a licensed Professional Structural Engineer experienced in design of this type of work and licensed in Tennessee.
C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.
D. Installer Qualifications: Supervisor along with trained elevator installation personnel on staff of elevator equipment manufacturer.
E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.07 WARRANTY
A. Provide manufacturer's warranty for elevator operating equipment and devices for one year from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Basis of Design - Electric Traction Elevators: KONE; EcoSpace Machine Roomless (MRL).
B. Other Acceptable Manufacturers - Electric Traction Elevators:
C. Substitutions: See Section 01.60.00 - Product Requirements.
   1. For any product not identified as Basis of Design, submit information as specified for substitutions.
D. Products other than Basis of Design are subject to compliance with specified requirements. By using products other than Basis of Design, the Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.
   1. Items included with costs associated to modifications noted above, but not necessarily limited to are:
      a. Structural changes in shaft sizes including walls, foundations and framing.
      b. Increased requirements for overhead runby space.
      c. Additional or increased bracing for lateral support of rails
      d. Increased electrical costs including overcurrent protection devices, conduit and conductors if the electrical motor size is increased by the different product.

2.02 ELECTRIC TRACTION ELEVATORS
A. Electric Traction Passenger Elevator:
   1. Electric Traction Elevator Equipment:
      b. Basis of Design is KONE EcoSpace Machine Roomles (MRL) with an adjacent room control space.
   2. Drive System:
      a. Synchronous alternating current (AC) motors and variable voltage variable frequency (VVVF) drive.
   3. Operation Control Type:
   4. Interior Car Height: 96 inch.
   5. Electrical Power: 480 volts; alternating current (AC); three phase; 60 Hz.
6. Rated Net Capacity: 4,000 lbs.
7. Rated Speed: 150 ft per minute.
10. Elevator Pit Depth: 60 inch.
11. Overhead Clearance at Top Floor: 156 inch.
12. Travel Distance: As indicated on drawings.
13. Number of Stops: As indicated on drawings.
15. Traction Machine Location: mounted to car guide rail at the top of the hoistway.

2.03 COMPONENTS
A. Elevator Equipment:
   1. Motors, Controllers, Controls, Buttons, Wiring, Devices, and Indicators: Comply with NFPA 70. Refer to Section 26.27.17.
   2. Guide Rails, Cables, Counterweights, Sheaves, Buffers, Attachment Brackets and Anchors: Design criteria for components includes safety factors in accordance with applicable requirements of Elevator Code, ASME A17.1.
   3. Buffers:
      a. Spring type for elevators with speed less than or equal to 200 feet per minute.
      b. Oil type for elevators with speed greater than 200 feet per minute.
   4. Lubrication Equipment:
      a. Provide grease fittings for periodic lubrication of bearings.
      b. Grease Cups: Automatic feed type.
      c. Lubrication Points: Visible and easily accessible.
B. Electrical Equipment:
   1. Motors: NEMA MG 1.
   2. Boxes, Conduit, Wiring, and Devices: As required by NFPA 70. Refer to Sections 26.05.34 and 26.27.17.
   3. Spare Conductors: Provide ten percent in extra conductors and two pairs of shielded audio cables in traveling cables.
   4. Include wiring and connections to elevator devices remote from hoistway and between elevator machine room. Provide additional components and wiring to suit machine room layout. Refer to Section 26.27.17.

2.04 PERFORMANCE REQUIREMENTS
A. Regulatory Requirements: Comply with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).
B. Accessibility Requirements: Comply with ADA Standards.
C. Perform structural steel design, fabrication, and installation in accordance with AISC 360.
D. Comply with seismic design requirements in accordance with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).
   1. Comply with Elevator Safety Requirements for Seismic Risk Zone in accordance with ASME A17.1, ASCE 7 and other related requirements.
   2. Provide earthquake emergency operations in accordance with ASME A17.1 requirements.
   3. Provide seismic switch in accordance with ASME A17.1 and ASCE 7 requirements.
E. Perform welding of steel in accordance with AWS D1.1/D1.1M.
F. Fabricate and install door and frame assemblies in accordance with NFPA 80 and in compliance with requirements of authorities having jurisdiction.
G. Perform electrical work in accordance with NFPA 70.
H. Comply with fire protection sprinkler system of the hoistway design in accordance with NFPA 13 requirements and authorities having jurisdiction.

2.05 MATERIALS
A. Rolled Steel Sections, Shapes, Rods: 1.
B. Steel Sheet: 1, Designation CS (commercial steel), with matte finish.
C. Stainless Steel Sheet: 1, Type 304; No. 4 Brushed finish unless otherwise indicated.
D. Extruded Aluminum: 2 and 1, natural anodized finish unless otherwise indicated.
E. Plywood: 1, Structural I, Grade C-D or better, sanded.

2.06 OPERATION CONTROLS
A. Elevator Controls: Provide landing operating panels and landing indicator panels.
   1. Landing Operating Panels: Metallic type, one for originating "Up" and one for originating "Down" calls, one button only at terminating landings; with illuminating indicators.
   3. Comply with ADA Standards for elevator controls.
B. Interconnect elevator control system with building security, fire alarm, card access, smoke alarm, and building management control systems.
C. Door Operation Controls:
   1. Program door control to open doors automatically when car arrives at floor landing.
   2. Render "Door Close" button inoperative when car is standing at dispatch landing with doors open.
   3. Door Safety Devices: Moveable, retractable safety edges, quiet in operation; equipped with photo-electric light rays.

2.07 OPERATION CONTROL TYPE
   1. Refer to description provided in ASME A17.1.
   2. Set system operation so that momentary pressure of landing button dispatches car from other landing to that landing.
   3. Allow call registered by momentary pressure of landing button at any time to remain registered until car stops in response to that landing call.
   4. If elevator car door is not opened within predetermined period of time after car has stopped at terminal landing allow car to respond to call registered from other landing.

2.08 EMERGENCY POWER
A. Set-up elevator operation to run with building emergency power supply when the normal building power supply fails, and in compliance with ASME A17.1 requirements.
B. Building Emergency Power Supply: Supplied by backup generator; provide elevator system components as required for emergency power characteristics with phase rotation the same as for normal power.
   1. Provide transfer switches and auxiliary contacts.
   2. Install connections to power feeders.
C. Elevator Emergency Power Supply: Supplied by battery backup; provide elevator system components as required for emergency power characteristics.
D. Emergency Lighting: Comply with ASME A17.1 elevator lighting requirements.
E. Provide operational control circuitry for adapting the change from normal to emergency power.
F. Upon transfer to emergency power, advance one elevator at a time to a pre-selected landing, stop car, open doors, disable operating circuits, and hold in standby condition.
2.09 MATERIALS
A. Rolled Steel Sections, Shapes, Rods: ASTM A36/A36M.
B. Steel Sheet: ASTM A1008/A108M, Designation CS (commercial steel), with matte finish.
C. Stainless Steel Sheet: ASTM A666, Type 304; No. 4 Brushed finish unless otherwise indicated.
D. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.
E. Extruded Aluminum: ASTM B221 (ASTM B221M), natural anodized finish unless otherwise indicated.
F. Plywood: PS 1, Structural I, Grade C-D or better, sanded.
H. Carpet Flooring: As specified in Section 09.68.00.
I. Plastic Laminate: NEMA LD 3, Type HGS, color as selected by Architect from manufacturer's standard line of colors.

2.10 CAR AND HOISTWAY ENTRANCES
A. Elevator, No. 1:
   1. Car and Hoistway Entrances, Main Elevator Lobby:
      a. Hoistway Fire Rating: 1 Hour.
      b. Elevator Door Fire Rating: 1 Hour.
      c. Framed Opening Finish and Material: Brushed stainless steel.
      d. Car Door Material: Stainless steel, with rigid sandwich panel construction.
      e. Hoistway Door Material: Stainless steel, with rigid sandwich panel construction.

2.11 CAR EQUIPMENT AND MATERIALS
A. Elevator Car, No. 1:
   1. Car Operating Panel: Provide main and auxiliary; flush-mounted applied face plate, with illuminated call buttons corresponding to floors served with "Door Open/Door Close" buttons, "Door Open" button, "Door Close" button, and alarm button.
      a. Panel Material: Integral with front return; one per car.
      b. Car Floor Position Indicator: Above car operating panel with illuminating position indicators.
      c. Locate alarm button where it is unlikely to be accidentally actuated; not more than 54 inch above car finished floor.
      d. Provide matching service cabinet integral with front return panel, with hinged door and keyed lock in each car.
      e. Provide following within service cabinet as part of car operating panel:
         1) Switch for each auxiliary operational control, keyed.
         2) Switches for fan, light, and inspection control.
         3) Emergency light.
         4) Telephone cabinet and hard-wired connection with telephone.
         5) Control for each other special feature specified.
   3. Flooring: Carpeting.
   4. Front Return Panel: Match material of car door.
   5. Door Wall: Plastic laminate on plywood.
   6. Hand Rail: Aluminum, at all three sides. Provide open clearance space 1-1/2 inch (38 mm) wide to face of wall.
      b. Aluminum Finish: Clear anodized.
   7. Ceiling:
a. Canopy Ceiling: Translucent plastic panel.
b. Lighting: As selected from manufacturer's standard line.
8. Provide emergency access panel for egress from car at ceiling.

B. Car Accessories:
   2. Protective Pads: Canvas cover, padded with impact-resistant fill material, sewn with piping edges; fire resistant in compliance with ASME A17.1; brass grommets for supports, covering side and rear walls and front return, with cut-out for control panel; provide one set for each elevator.
      a. Color: As selected by Architect.
      b. Provide at least 4 inch clearance from bottom of pad to finished floor.
      c. Pad Supports: Stainless steel studs, and mounted from top of wall panels.

2.12 HOISTWAY ENTRANCES

A. Hoistway Entrances; Main Floor Elevator Lobby:
   3. Hoistway Fire Rating: 1 Hour.
   4. Door Fire Rating: 1 Hour.

B. Hoistway Entrances; Upper Floor Elevator Landings:
   3. Hoistway Fire Rating: 1 Hour.
   4. Door Fire Rating: 1 Hour.

C. Car Doors:
   2. Car Doors: 18 gage, 0.0478 inch minimum sheet thickness, rigid sandwich panel construction.
   3. Door Fire Rating: 1 Hour.

D. Hoistway Entrances and Car Doors:
   1. Width: As indicated on drawings.
   2. Height: 84 inch.
   3. Door Type: Double leaf.
   4. Door Operation: Center opening, single speed.

2.13 FINISHES

A. Clear Anodized Finish: Class I, AAMA 611 AA-M12C22A41 Clear anodic coating with electrolytically deposited organic seal; not less than 0.7 mils thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting this work.
B. Verify that hoistway, pit, and machine room are ready for work of this section.
C. Verify hoistway shaft and openings are of correct size and within tolerance.
D. Verify that electrical power is available and of correct characteristics.
3.02 PREPARATION
A. Arrange for temporary electrical power for installation work and testing of elevator components. Comply with requirements of Section 01.50.00 - Temporary Facilities and Controls.
B. Maintain elevator pit excavation free of water.

3.03 INSTALLATION
A. Coordinate this work with installation of hoistway wall construction.
B. Install system components, and connect equipment to building utilities.
C. Provide conduit, electrical boxes, wiring, and accessories. Refer to Sections 26.05.34 and 26.27.17.
D. Mount machines and motors on vibration and acoustic isolators.
   1. Place on structural supports and bearing plates.
   2. Securely fasten to building supports.
   3. Prevent lateral displacement.
E. Install hoistway, elevator equipment, and components in accordance with approved shop drawings.
F. Install guide rails to allow for expansion and contraction movement of guide rails.
G. Accurately machine and align guide rails, forming smooth joints with machined splice plates.
H. Field Welds: Chip and clean away oxidation and residue with wire brush; spot prime with two coats.
I. Install hoistway door sills, frames, and headers in hoistway walls; grout sills in place, set hoistway floor entrances in alignment with car openings, and align plumb with hoistway.
J. Fill hoistway door frames solid with grout in accordance with Section 04.20.00.
K. Structural Metal Surfaces: Clean surfaces of rust, oil or grease; wipe clean with solvent; prime with two coats.
L. Wood Surfaces not Exposed to Public View: Finish with one coat primer; one coat enamel.
M. Adjust equipment for smooth and quiet operation.

3.04 TOLERANCES
A. Guide Rail Alignment: Plumb and parallel to each other in accordance with ASME A17.1 and ASME A17.2.
B. Car Movement on Aligned Guide Rails: Smooth movement, without any objectionable lateral or oscillating movement or vibration.

3.05 FIELD QUALITY CONTROL
A. Testing and inspection by regulatory agencies certified in accordance with ASME QEI-1 will be performed at their discretion.
   1. Schedule tests with agencies and notify Owner and Architect.
   2. Obtain permits as required to perform tests.
   3. Document regulatory agency tests and inspections in accordance with requirements.
   4. Perform tests required by regulatory agencies.
   5. Furnish test and approval certificates issued by authorities having jurisdiction.
B. Operational Tests:
   1. Perform operational tests in the presence of Owner and Architect.
   2. Test single elevator system by transporting at least 20 persons up from main floor to top floor landings during a five minute period.
   3. At an agreed time, and the building occupied with normal building traffic, conduct tests to verify performance.
3.06 ADJUSTING
A. Adjust for smooth acceleration and deceleration of car to minimize passenger discomfort.
B. Adjust with automatic floor leveling feature at each floor landing to reach 1/4 inch maximum from flush with sill.

3.07 CLEANING
A. Remove protective coverings from finished surfaces.
B. Clean surfaces and components in accordance with manufacturers written instructions.

3.08 CLOSEOUT ACTIVITIES
A. Demonstrate proper operation of equipment to Owner's designated representative.
B. Demonstration: Demonstrate operation of system to Owner's personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Briefly describe function, operation, cleaning and maintenance of each component.
C. Training: Train Owner's personnel on cleaning and operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.
   3. Instructor: Manufacturer's training personnel.
   4. Location: At project site, unless noted otherwise.

3.09 PROTECTION
A. Do not permit construction traffic within car after cleaning.
B. Protect installed products until Date of Substantial Completion.
C. Touch-up, repair, or replace damaged products and materials before Date of Substantial Completion.

3.10 MAINTENANCE
A. Provide Initial Maintenance Contract of elevator system and components in accordance with ASME A17.1 and requirements as indicated for 12 months from Date of Substantial Completion.
B. Submit proposal for continuation of Maintenance Contract in accordance with ASME A17.1 and requirements as indicated for installed elevator equipment.
C. Perform maintenance contract services using competent and qualified personnel under the supervision and direct employ of the elevator manufacturer or installer.
D. Maintenance contract services shall not be assigned or transferred to any agent or other entity without prior written consent of Owner.
E. Examine system components monthly.
F. Include systematic examination, adjustment, and lubrication of elevator equipment.
G. Maintain and repair or replace parts, whenever required, using parts produced by original equipment manufacturer.
H. Replace wire ropes when necessary to maintain the required factor of safety.
I. Perform work without removing cars from use during peak traffic periods.
J. Provide emergency call back service on overtime throughout period of this maintenance contract.
K. Maintain an adequate stock of parts for replacement or emergency purposes, and have personnel available to ensure the fulfillment of this maintenance contract without unreasonable loss of time.

END OF SECTION 14.21.00
PART 1 GENERAL

1.01 SECTION INCLUDES
   A. Enclosed, self-contained vertical platform wheelchair lift.

1.02 RELATED SECTIONS
   A. Section 03 30 00 - Cast-In-Place Concrete: Concrete shaftway and anchor placement.
   B. Section 04 20 00 - Unit Masonry: Masonry shaftway and anchor placement.
   C. Section 06 10 00 - Rough Carpentry: Blocking in framed construction for lift attachment.
   D. Section 09 21 16 - Gypsum Board Assemblies: Gypsum board shaftway.
   E. Division 26 - Electrical: Dedicated telephone service and wiring connections.
   F. Division 26 - Electrical: Lighting and wiring connections at top of shaft.
   G. Division 26 - Electrical: Electrical power service and wiring connections.

1.03 REFERENCES
   B. ASME A17.5 - Elevator and Escalator Electrical Equipment.

1.04 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. Submit manufacturer's installation instructions, including preparation, storage and handling requirements.
      2. Include complete description of performance and operating characteristics.
      3. Show maximum and average power demands.
   C. Shop Drawings:
      1. Show typical details of assembly, erection and anchorage.
      2. Include wiring diagrams for power, control, and signal systems.
      3. Show complete layout and location of equipment, including required clearances and coordination with shaftway.
   D. Selection Samples: For each finished product specified, provide two complete sets of color chips representing manufacturer's full range of available colors and patterns.
   E. Verification Samples: For each finished product specified, two samples, minimum size 1-3/4” x 2-1/4” inches, representing actual product, color, and patterns.

1.05 QUALITY ASSURANCE
   A. Manufacturer Qualifications: Firm with minimum 10 years experience in manufacturing of vertical platform lifts, with evidence of experience with similar installations of type specified.
   B. Installer Qualifications: Licensed to install equipment of this scope, with evidence of experience with specified equipment. Installer shall maintain an adequate stock of replacement parts, have qualified
people available to ensure fulfillment of maintenance and callback service without unreasonable loss of time in reaching project site.

1.06 REGULATORY REQUIREMENTS
A. Provide platform lifts in compliance with:
   3. ASME A17.5 - Elevator and Escalator Electrical Equipment.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store components off the ground in a dry covered area, protected from adverse weather conditions.

1.08 PROJECT CONDITIONS
A. Do not use wheelchair lift for hoisting materials or personnel during construction period.

1.09 WARRANTY
A. Warranty: Manufacturer shall warrant the wheelchair lift materials and workmanship for two years following completion of installation.
B. Extended Warranty: Provide an extended manufacturer’s warranty for the entire warranty period covering the wheelchair lift materials and workmanship for the following additional extended period beyond the initial two year warranty. Preventive Maintenance agreement required.
   1. Five additional years.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Basis of Design: Garaventa Lift; United States - P.O. Box 1769, Blaine, WA Toll Free: 800-663-6556. Tel: (604) 594-0422. Fax: (604) 594-9915; www.garaventalift.com; Email: productinfo@garaventalift.com
B. Substitutions: Subject to meeting these specifications other manufacturer's products will be considered.
C. Requests for substitutions will be considered in accordance with provisions of Section 01 25 13.

2.02 ENCLOSED VERTICAL WHEELCHAIR LIFT
A. Capacity: 750 lbs (340 kg) rated capacity.
B. Mast Height:
   1. Model GVL-EN-120; 123 inches (3124 mm) maximum lifting height.
C. Nominal Clear Platform Dimensions:
   1. Standard: 37-1/4 inches (947 mm) by 54 inches (1370 mm).
D. Platform Configuration:
E. Landing Openings:
   1. Lower Landing: Door.
   2. Upper Landing: Gate.
F. Doors and Gates: Doors and gates shall be self closing type.
   1. Door Height: Flush mount, 80 inches (2032 mm).
   2. Gate Height: Flush mount, 42-1/8 inches (1070 mm).
3. Door Construction: Aluminum frame with:
   a. Panels of 16 gauge (1.5 mm) painted galvanized steel.

4. Power Door/Gate Operator: Automatically opens the door/gate when platform arrives at a landing. Will also open at landing by pressing call button.
   a. ADA Compliant and obstruction sensitive.
   b. Low voltage, 24 VDC with all wiring concealed.
   c. Location:
      1) Lower Landing: Door.
      2) Upper landing: Door or Gate.

G. Lift Components:
   3. Platform Side Wall Panels: 42-1/8 (1070 mm) inches high. 16 gauge (1.5 mm) galvanized steel sheet. Custom aluminum extrusion tubing frame.
   4. Enclosure Panels:
      a. 16 gauge (1.5 mm) painted galvanized steel sheet.

H. Enclosure Height Above Upper landing:
   1. Enclosure shall extend 42-1/8 inches (1070 mm) above the upper landing level

I. Infill Panel Kit: Provide 16 gauge (1.5 mm) galvanized panels and mounting hardware to cover void between side of enclosure, drive mast and adjacent wall at the following locations:
   1. Lower landing.
   2. Upper landing.

J. Base Mounting and Access to Lift at Lower Landing:
   1. Pit Mount: Lift to be mounted in pit with dimensions to meet manufacturers requirements for the platform size specified. Pit construction shall be in accordance to Section 03300.

K. Leadscrew Drive:
   1. Drive Type: Self-lubricating acme screw drive.
   2. Battery Powered Emergency Lowering: Battery powered platform lowering device that automatically activates in the event of power failure. Allows passenger to drive platform downward to lower landing. Does not operate lift in up direction.
   3. Safety Devices:
      a. Integral safety nut assembly with safety switch.
   4. Travel Speed: 10 fps (3.0 m/minute).
   5. Motor: 2.0 hp (560 W).
   6. Power Supply:
      a. 120 VAC single phase; 60 Hz on a dedicated 20-amp circuit.
      b. 208/240 VAC, single phase; 50 Hz on a dedicated 16-amp circuit.

L. Hydraulic Drive:
   1. Drive Type: Chain hydraulic.
   2. Emergency Operation: Manual device to lower platform and use auxiliary battery power to raise or lower platform.
   3. Safety Devices:
      a. Slack chain safety device.
      b. Shoring device.
   4. Travel Speed: 17 fps (5.2 m/minute).
   5. Motor: 3.0 hp (2.2 kW); 24 volts DC.
   6. Power Supply:
      a. 120 VAC single phase; 60 Hz on a dedicated 15-amp circuit.
      b. 208/240 VAC, single phase; 50 Hz on a dedicated 16-amp circuit.
c. Powered by building continuous mains converted to 24 VDC and equipped with auxiliary battery backup power system capable of running lift up and down for a minimum of 5 trips with rated load. Required for high use lifts and lifts equipped with a fan and ventilation system.

M. Platform Controls: 24 VDC control circuit with the following features.
   1. Direction Control: Illuminated tactile and constant pressure push buttons with dual platform courtesy lights and safety light.
   2. Illuminated and audible emergency stop switch shuts off power to lift and activates audio alarm equipped with battery backup.
   4. Emergency Telephone: Platform shall be equipped with ADA compliant autodialer telephone with a stainless steel faceplate. Telephone shall operate in the event of power failure. A telephone line shall be supplied to the lift site as specified under Division 26.
   5. Arrival Gong and Digital Floor Display.

N. Call Station Controls: 24 VDC control circuit with the following features.
   1. Direction Control: Illuminated tactile and constant pressure push buttons with illuminated "In Use" indicator.
   2. Keyed operation.
   3. Call Station Mounting:
      a. Lower:
         1) Frame mounted.
      b. Upper:
         1) Frame mounted.

O. Safety Devices and Features:
   1. Grounded electrical system with upper, lower, and final limit switches.
   2. Tamper resistant interlock to electrically monitor that the door is in the closed position and the lock is engaged before lift can move from landing.
   3. Pit stop switch mounted on mast wall.
   4. Electrical disconnect shall shut off power to the lift.

P. Finishes
   1. Lift Finish: Baked powder coat finish, color as selected by the Architect from manufacturers optional RAL color chart.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Do not begin installation until substrates have been properly prepared.
   B. Verify shaft and machine space are of correct size and within tolerances.
   C. Verify required landings and openings are of correct size and within tolerances.
   D. Verify electrical rough-in is at correct location.
   E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 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.
3.03 INSTALLATION
   A. Install platform lifts in accordance with applicable regulatory requirements including ASME A 17.1, ASME A 18.1 and the manufacturer’s instructions.
   B. Install system components and connect to building utilities.
   C. Accommodate equipment in space indicated.
   D. Startup equipment in accordance with manufacturer’s instructions.
   E. Adjust for smooth operation.

3.04 FIELD QUALITY CONTROL
   A. Perform tests in compliance with ASME A 17.1 or A18.1 and as required by authorities having jurisdiction.
   B. Schedule tests with agencies and Architect, Owner, and Contractor present.

3.05 PROTECTION
   A. Protect installed products until completion of project.
   B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 14.42.16
PART 1  GENERAL

1.01  SECTION INCLUDES
A. Vertical platform wheelchair lift installed within shaftway.

1.02  RELATED SECTIONS
A. Section 03 30 00 - Cast-In-Place Concrete: Concrete shaftway and anchor placement.
B. Section 04 20 00 - Unit Masonry: Masonry shaftway and anchor placement.
C. Section 06 10 00 - Rough Carpentry: Blocking in framed construction for lift attachment.
D. Section 09 26 00 - Gypsum Board Assemblies: Gypsum board shaftway.
E. Division 26 - Electrical: Dedicated telephone service and wiring connections.
F. Division 26 - Electrical: Lighting and wiring connections at top of shaft.
G. Division 26 - Electrical: Electrical power service and wiring connections.

1.03  REFERENCES
B. ASME A17.5 - Elevator and Escalator Electrical Equipment.

1.04  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. Submit manufacturer's installation instructions, including preparation, storage and handling requirements.
   2. Include complete description of performance and operating characteristics.
   3. Show maximum and average power demands.
C. Shop Drawings:
   1. Show typical details of assembly, erection and anchorage.
   2. Include wiring diagrams for power, control, and signal systems.
   3. Show complete layout and location of equipment, including required clearances and coordination with shaftway.
D. Selection Samples: For each finished product specified, provide two complete sets of color chips representing manufacturer's full range of available colors and patterns.
E. Verification Samples: For each finished product specified, two samples, minimum size 1-3/4” x 2-1/4”, representing actual product, color, and patterns.

1.05  QUALITY ASSURANCE
A. Manufacturer Qualifications: Firm with minimum 10 years experience in manufacturing of vertical platform lifts, with evidence of experience with similar installations of type specified.
B. Installer Qualifications: Licensed to install equipment of this scope, with evidence of experience with specified equipment. Installer shall maintain an adequate stock of replacement parts, have qualified
people available to ensure fulfillment of maintenance and callback service without unreasonable loss of
time in reaching project site.

1.06 REGULATORY REQUIREMENTS
A. Provide platform lifts in compliance with:
   3. ASME A17.5 - Elevator and Escalator Electrical Equipment.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store components off the ground in a dry covered area, protected from adverse weather conditions.

1.08 PROJECT CONDITIONS
A. Do not use wheelchair lift for hoisting materials or personnel during construction period.

1.09 WARRANTY
A. Warranty: Manufacturer shall warrant the wheelchair lift materials and workmanship for two years
   following completion of installation.
B. Extended Warranty: Provide an extended manufacturer’s warranty for the entire warranty period covering
   the wheelchair lift materials and workmanship for the following additional extended period beyond the
   initial two year warranty. Preventive Maintenance Agreement required.
   1. Five additional years.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Basis of Design: Garaventa Lift; United States - P.O. Box 1769, Blaine, WA Toll Free: 800-663-6556.
   Tel: (604) 594-0422. Fax: (604) 594-9915; www.garaventalift.com; Email:
   productinfo@garaventalift.com
B. Substitutions: Subject to meeting these specifications other manufacturer's products will be considered.
C. Requests for substitutions will be considered in accordance with provisions of Section 01 25 13.

2.02 SHAFTWAY VERTICAL WHEELCHAIR LIFT
A. Capacity: 750 lbs. (340 kg) rated capacity.
B. Mast Height:
   1. Model GVL SW -120; 123 inches (3124 mm) maximum lifting height.
C. Nominal Clear Platform Dimensions:
   1. Standard: 39 inches (992 mm) by 54 inches (1370 mm).
D. Platform Configuration:
   1. On/Off Same Side Entry/Exit: One front opening only.
E. Landing Openings:
   1. Lower Landing: Door.
   2. Upper Landing: Door.
F. Door Construction:
1. Fire Rated Doors: 1-1/2 hour B label rating. Pre-hung, constructed of 16 gauge (1.5 mm) steel, with a vision panel, delayed action door closer, pull handle and integrated interlock. Doors mount flush to the inside wall of the shaftway.

2. Door Width:
   a. Lower Landing:
      1) 35-5/8 inches (905 mm).
   b. Upper landing:
      1) 35-5/8 inches (905 mm).

G. Power Door Operator: Automatically opens the door/gate when platform arrives at a landing. Will also open at landing by pressing call button.
   1. ADA Compliant and obstruction sensitive.
   2. Low voltage, 24 VDC with all wiring concealed.
   3. Provide power operators at the following locations:
      a. Lower Landing: Door.
      b. Upper landing: Door or Gate.

H. Lift Components:
   2. Base Frame: Structural steel tubing.
   3. Platform Side Wall Panels: 16 gauge (1.5 mm) galvanized steel sheet. Custom aluminum extrusion tubing frame.

I. Base Mounting and Access to Lift at Lower Landing:
   1. Pit Mount: Lift to be mounted in pit with dimensions to meet manufacturers requirements for the platform size specified. Pit construction shall be in accordance to Section 03300.

J. Drive Mast Side Wall Panels: Provide 16 gauge (1.5 mm) galvanized panels and mounting hardware to cover the void between both sides of the mast and the side of the shaftway. Panels to cover the front and top of the void area to the height of the top surface of the drive mast.

K. Leadscrew Drive:
   1. Drive Type: Self-lubricating acme screw drive.
   2. Emergency Operation: Manual handwheel device to raise or lower platform.
   4. Safety Devices:
      a. Integral safety nut assembly with safety switch.
      b. Shoring device.
   5. Travel Speed: 10 fpm (3.0 m/minute).
   7. Power Supply:
      a. 120 VAC single phase; 60 Hz on a dedicated 20 amp circuit.
      b. 208/240 VAC, single phase; 50 Hz on a dedicated 16 amp circuit.

L. Hydraulic Drive:
   1. Drive Type: Chain hydraulic.
   2. Emergency Operation: Manual device to lower platform and auxiliary battery power to raise or lower platform.
   3. Safety Devices:
      a. Slack chain safety device.
      b. Shoring device.
   4. Travel Speed: 17 fpm (5.2 m/minute).
   5. Motor: 3.0 hp (2.2 kW); 24 volts DC.
   6. Power Supply:
a. 120 VAC single phase; 60 Hz on a dedicated 15 amp circuit.
b. 208/240 VAC, single phase; 50 Hz on a dedicated 16 amp circuit.
c. Powered by continuous building mains converted to 24 VDC equipped with auxiliary battery power system capable of running lift up and down for a minimum of 5 trips with rated load. Required for high usage lifts.
d. Powered by continuously charged battery system.

M. Platform Controls: 24 VDC control circuit with the following features.
   1. Direction Control: Illuminated tactile and constant pressure buttons with dual platform courtesy lights and safety light.
   2. Illuminated and audible emergency stop switch shuts off power to lift and activates audio alarm equipped with battery backup.
   4. Emergency Telephone: Platform shall be equipped with ADA compliant autodialer telephone with a stainless steel faceplate. Telephone shall operate in the event of power failure. A telephone line shall be supplied to the lift site as specified under Division 16.
   5. Arrival Gong and Digital Floor Display.

N. Call Station Controls: 24 VDC control circuit with the following features.
   1. Direction Control: Illuminated and tactile constant pressure buttons with illuminated “in-use” indicator.
   2. Safety indicator lamp.
   4. Call Station Mounting:
      a. Lower:
         1) Wall mounted recessed.
      b. Upper:
         1) Wall mounted recessed.

O. Safety Devices and Features:
   1. Grounded electrical system with upper, lower, and final limit switches.
   2. At all landings a solenoid activated interlock shall electrically monitor that the door is in the closed position and the lock is engaged before lift can move from landing.
   3. Pit stop switch mounted on mast wall.
   4. Electrical disconnect shall shut off power to the lift.

P. Finishes
   1. Lift Finish: Baked powder coat finish as selected by the Architect from manufacturer’s optional RAL color chart.

PART 3 EXECUTION

3.01 EXAMINATION
   A. Do not begin installation until substrates have been properly prepared.
   B. Verify shaft and machine space are of correct size and within tolerances.
   C. Verify required landings and openings are of correct size and within tolerances.
   D. Verify electrical rough-in is at correct location.
   E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 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.

3.03 INSTALLATION

A. Install platform lifts in accordance with applicable regulatory requirements including ASME A 17.1, ASME A 18.1 and the manufacturer's instructions.
B. Install system components and connect to building utilities.
C. Accommodate equipment in space indicated.
D. Startup equipment in accordance with manufacturer’s instructions.
E. Adjust for smooth operation.

3.04 FIELD QUALITY CONTROL

A. Perform tests in compliance with ASME A 17.1 or A18.1 and as required by authorities having jurisdiction.
B. Schedule tests with agencies and Architect, Owner, and Contractor present.

3.05 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 14.42.18
PART 1 - GENERAL

1.01 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) 13-2012 Edition.

1.02 DEFINITIONS
A. Working Plans: Documents, including shop drawings, calculations, and material specifications prepared according to NFPA 13, 14, and 24 for obtaining approval from authorities having jurisdiction.

1.03 SYSTEM PERFORMANCE REQUIREMENTS
A. Sprinkler systems 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

2.01 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.

2.02 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.

2.03 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.

2.04 SWITCHES
A. Provide all tamper and flow switches for indicating control valves and systems and as required by local ordinances.

2.05 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

2.06 BACKFLOW PREVENTERS
   A. Double Check Device: UL listed and FM approved, ASSE and USC approved double check backflow preventer consisting of two resilient seated full flow isolation valves, two independently operating, spring loaded poppet-type internally epoxy coated cast iron check valves and four resilient seated test cocks for field testing. Stainless steel springs and corrosion resistant materials shall be used throughout. Working pressure rating of 175 PSI. Preventer assembly to be lien size or size as called for on drawings. Backflow preventer shall be a Watts, Silver Buller, or Febco mount 4 foot maximum above the floor.

2.07 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).

2.08 FIRE DEPARTMENT CONNECTIONS
   A. Water-Flow Indicators: UL 346; electrical-supervision, vane-type water-flow detector; with 250 psig 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.

2.09 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.

PART 3 - EXECUTION

3.01 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.

3.02 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.

3.03 HANGER ATTACHMENTS
   A. Support of pipes with diameter larger than 2 ½ 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.
3.04 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.

3.05 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

1.01 QUALITY ASSURANCE
   A. Conform to the following:
      1. International Plumbing Code - 2012

1.02 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.

1.03 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

1.04 REGULATORY REQUIREMENTS
   A. Perform Work specified in Division 22 in accordance with 2012 IPC and by the authority having jurisdiction.

1.05 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.

1.06 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.

1.07 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.

1.08 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 (Not Used)

PART 3 - EXECUTION

3.01 EXCAVATING AND BACKFILLING
A. Provide trenching, excavating, and backfilling necessary for performance of plumbing work in accordance with Division 02.

3.02 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.

3.03 FLASHING AND COUNTERFLASHING
A. Counterflash pipes where penetration of roofs and outside walls occur.

3.04 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.

3.05 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.

3.06 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.

3.07 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 flush valves for proper operation.

END OF SECTION 22.05.00
PART 1 - GENERAL (NOT USED)

PART 2 - PRODUCTS

2.01 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.

2.02 PIPE MARKERS
   A. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering.

2.03 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. Identification includes domestic cold water; hot water; recirculation hot water; rainwater; storm; waste; gas.
      3. All piping in mechanical rooms shall be labeled to identify contents and direction of flow.

2.04 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 heaters
      2. Pumps
      3. 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

3.01 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
1.01 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.

1.02 EXISTING SERVICES
   A. Maintain existing services in operation during construction. Coordinate and schedule all service interruptions 
with Owner.

2.01 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.

2.02 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. Jackets for Piping Insulation: ASTM C 921, Type I for piping with temperatures below ambient, Type II for 
piping with temperatures above ambient. Type I may be used for all piping at Installers option.
      1. Encase pipe fittings, valves, strainers, etc. with insulation with glass fabric and vapor barrier mastic 
         applied as per manufacturer’s recommendations.
   D. Encase the following with 0.016” smooth aluminum jacket, secured with sheet metal screws and 1/4-inch 
aluminum bands. Fittings shall be covered with factory-formed aluminum elbow covers.
      1. All interior piping insulation within 7'-0” of floors or work surfaces.
      2. All valves, fittings, etc. within 7'-0” of floors or work surfaces.
      3. All fittings within 7'-0” of floors or work surfaces to be covered with factory formed aluminum elbow 
         covers.
   E. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.
   F. Tees and elbows for insulated piping shall be factory premolded insulation fittings, similar to that 
manufactured by Hamfab.
   G. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications 
indicated.

2.03 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

3.01 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.

3.02 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 and rain 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 2 · 0F):
   a. Fiberglass: 1/2” thickness for cold water.
   b. Fiberglass: 1” thickness for storm/rain 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 2 · 0F):
   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.

3.03 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.

3.04 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.

3.05 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.

END OF SECTION 22.07.19
SECTION 22.10.05
PLUMBING PIPING & VALVES

PART 1 - GENERAL

1.01 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

2.01 SANITARY SEWER PIPING, BURIED
A. PVC Pipe: ASTM D 2665 or ASTM D 3034.
   1. Fittings: PVC.

2.02 SANITARY SEWER AND CONDENSATE PIPING, ABOVE GRADE
A. Sanitary Sewer - Cast Iron Pipe: CISPI 301, hubless service weight.
   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.

2.03 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.

2.04 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.

2.05 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.

2.06 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:
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.

2.07 BALL VALVES
A. Construction, under 2 Inches: MSS SP-110, Class 150, 400 psi 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.

2.08 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.

2.09 ESCUTCHEONS
A. Provide chrome plated escutcheons where insulated pipes penetrate walls or ceilings of finished spaces.

PART 3 - EXECUTION

3.01 EXAMINATION
A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 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.

3.03 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.

3.04 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.

3.05 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.

3.06 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.
3.07 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.

3.08 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.

3.09 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

2.01 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 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 22.11.23
DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.01 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

2.01 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

3.01 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
PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide a factory packaged, electric storage type domestic water heater.

PART 2 - PRODUCTS

2.01 ELECTRIC, DOMESTIC-WATER HEATER

A. Electric, Storage, Domestic-Water Heater:
   2. Storage-Tank Construction: Steel.
      b. Pressure Rating: 150 psig (1035 kPa).
      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.

2.02 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

3.01 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.

3.02 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 22.34.05
WATER HEATER, GAS FIRED

PART 1 - GENERAL

1.01 DESCRIPTION
A. Provide a factory packaged, natural gas fired, storage type domestic water heater.

PART 2 - PRODUCTS

2.01 EQUIPMENT
A. Unit manufactured by Hesco, Ruud, or A. O. Smith. Model number, capacity, accessories scheduled on drawings.
B. Storage tank to be carbon steel, epoxy glass lined, ASME Code stamped for 150 psi working pressure.
C. Burners to be stainless steel and 100% safety shutoff controls.
D. ASME temperature and pressure relief valve.
E. Fiberglass insulation with steel jacket.
F. Operating Instructions

PART 3 - EXECUTION

3.01 INSTALLATION
A. Verify location and clearance requirements.
B. Installation in accordance with manufacturers’ installation instructions.

END OF SECTION 22.34.05
SECTION 23.05.00
GENERAL PROVISION FOR HVAC

PART 1 - GENERAL

1.01 QUALITY ASSURANCE
A. Conform to the following:
   2. International Mechanical Code - 2012

1.02 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.

1.03 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. Air Handling Equipment
      c. Air Terminal Units
      d. Fan Coil Units
      e. Air Distribution, Ductwork, Grilles, Registers
      f. Insulation
      g. Filters
      h. Vibration Isolation
      i. Boilers
      j. Chillers
      k. Pumps and Hydronic Specialties
      l. Sound attenuators
      m. Steam/Hot Water Heat Exchanger
      n. VFD's
      o. Motors
      p. Fans
      q. Fire Dampers
      r. Valves, Traps and Strainers
      s. Water Treatment System
1.04 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.

1.05 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.
   B. Comply with the applicable edition date of each regulation as adopted by the authorities having
      jurisdiction.

1.06 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.

1.07 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.

1.08 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.

1.09 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

2.01 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, 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: Adjustable pipe roll stands with baseplate.

2.02 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.

2.03 FLASHINGS AND COUNTERFLASHINGS
   A. Furnish materials and coordinate installation for flashing and counterflashng roof penetrations for vents, pipe, drains, and ducts.

PART 3 EXECUTION

3.01 EXCAVATING AND BACKFILLING
   A. Provide trenching, excavating, and backfilling necessary for performance of mechanical work in accordance with Division 02.

3.02 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.

3.03 FLASHING AND COUNTERFLASHING
   A. Counterflash ducts and pipes where penetration of roofs and outside walls occur.

3.04 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.

3.05 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. 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.

3.06 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.

3.07 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.

3.08 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 and boiler. 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.

3.09 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. 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
SECTION 23.05.05
USE OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.01 GENERAL
A. Provide all labor, materials, tools, and services required; maintain warranties and keep equipment in operating condition.
B. Principal equipment included are:
   1. Chillers
   2. Boilers
   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 boilers 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.

1.02 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
PART 1 - GENERAL

1.01 SUBMITTALS
A. Submit motor information with submittals and shop drawings.

1.02 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

2.01 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 invertor 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.

### 2.02 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

3.01 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.

3.02 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
SECTION 23.05.14
VARIABLE FREQUENCY MOTOR DRIVES

PART 1 - GENERAL

1.01 GENERAL
A. Furnish complete variable frequency motor controllers (VSMC) for fans and pumps designated.

1.02 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 born by the manufacturer, including travel costs or living expenses necessary to repair in warranty equipment.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS
A. ABB or approved equal.

2.02 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 sinewave 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.

2.03 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.

2.04 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/Restart:
   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

3.01 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.

3.02 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, ESCUTCHEONS, AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL (Not Applicable)

PART 2 - PRODUCTS

2.01 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.

2.02 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.

2.03 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

2.04 PENETRATION SEALS
A. Refer to architectural specification for Fire Safing.

2.05 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.

2.06 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

3.01 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.”

3.02 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.

3.03 ESCUTCHEONS
A. Provide escutcheons where exposed piping passes through walls, floors, and ceilings in finished areas.

3.04 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.

3.05 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

2.01 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. Hot water piping above 160 degrees F. 4" diameter and less.
   2. 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. 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.

2.02 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.

2.03 EXPANSION ANCHORS

A. Hilti Kwik-bolt, zinc plated, metal expansion anchor.

B. Anchor to meet U.L., ICBO-4627 and FM listings.

2.04 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.

2.05 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.

2.06 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.

2.07 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.

2.08 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.

2.09 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 at all roof ductwork and piping penetrations and for support of all roof-mounted equipment, fans and ductwork. 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 nailing. 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 duct 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

3.01 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.

F. Equipment support in first paragraph below requires calculating and detailing at each use.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. 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.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. 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.

M. 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 (DN 100) 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 (DN 100) and larger if pipe is installed on rollers.

4. Pipes NPS 8 (DN 200) 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.

3.02 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.

3.03 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.

3.04 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.

3.05 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.

3.06 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
PART 1 - GENERAL

1.01 SUMMARY
   A. Furnish and install a complete U.L. listed system of heaters, components, and controls to prevent chilled water pipe lines from freezing.

1.02 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

2.01 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>
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<tbody>
<tr>
<td>3 inch or less</td>
<td>5</td>
</tr>
<tr>
<td>4 to 6</td>
<td>8</td>
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<td>8</td>
<td>10</td>
</tr>
<tr>
<td>10 to 16</td>
<td>16</td>
</tr>
</tbody>
</table>

2.02 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.
2.03 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

3.01 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."

3.02 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

1.01 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

2.01 ACCEPTABLE MANUFACTURERS
A. Kinetics Noise Control or Mason Industries. Provide isolators by a single manufacturer.

2.02 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.

2.03 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 centrifugal in line fans (minimum 2" deflection)

2.04 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 chillers.

2.05 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

3.01 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

1.01 SUMMARY (Not Applicable)

PART 2 - PRODUCTS

2.01 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.

2.02 PIPE MARKERS
   A. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering.

2.03 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 and hot water piping.
   B. All piping in equipment rooms and concealed in accessible spaces (such as piping above lay-in ceiling space) shall be labeled to identify contents and direction of flow.

2.04 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. Chillers
      2. Boilers
      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 mechanical room housing an A/C systems 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)

END OF SECTION 23.05.53
PART 1 - GENERAL

1.01 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

3.01 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.

3.02 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. Shutoff 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.

3.03 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, fan-speed-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.

### 3.04 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 louver 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.

### 3.05 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.

f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.

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.

3.06 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.

### 3.07 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.

### 3.08 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.

3.09 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. Boiler test forms - Record the following items on each boiler 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, 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 cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Suction static pressure in 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 deg F.
      d. Duct static pressure in inches wg.
      e. Duct size in inches.
      f. Duct area in sq. ft.
      g. Indicated airflow rate in cfm.
      h. Indicated velocity in fpm.
      i. Actual airflow rate in cfm.
      j. Actual average velocity in fpm.
      k. Barometric pressure in 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 sq. ft.
   2. Test Data (Indicated and Actual Values):
      a. Airflow rate in cfm.
      b. Air velocity in fpm.
      c. Preliminary airflow rate as needed in cfm.
      d. Preliminary velocity as needed in fpm.
      e. Final airflow rate in cfm.
      f. Final velocity in fpm.
      g. Space temperature in 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. Low pressure supply and return ductwork.
      b. Plenums serving sidewall return and supply grilles.
      c. 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-resistive 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.
B. Section includes insulating the following HVAC equipment that is not factory insulated.
   1. Boiler
   2. Chilled Water Pump
   3. Hot Water Heating Pump
   4. Expansion Tanks
   5. Air Separators

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. Chilled water pump casings and flanges: 1" thick
      b. Chilled water piping valves, strainers and hydronic specialties: 1" thick
      c. Air separators - 1-1/2" thick
      d. Refrigeration machine cooler, suction piping and pipe connections: 1-1/2" thick.
E. 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. Drain bodies, traps and horizontal drain lines receiving cold condensate - 1/2" 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. Premolded insulation fittings shall be equal to those manufactured by Hamfab. Premolded 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 mechanical pipe and fittings within 7'-0" of floors or work surfaces in mechanical rooms and outdoors shall be protected with 0.016" thick smooth, aluminum jacket using factory formed aluminum covers for fittings and valves and secured with self-tapping crews and drawbands. No corrugated jacket with be allowed. Install jacket seams on bottom of pipe.

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-resistive 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 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:
   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
PART 1 - GENERAL

1.1 DESCRIPTION

A. The Direct Digital Control/Building Automation System (DDC/BAS) shall be Johnson Controls Metasys or approved equal.

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.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      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 NETWORK AUTOMATION ENGINES (NAE)
A. Network Automation Engine (NAE 45XX)
   1. The Network Automation Engine (NAE) shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.
   2. Automation network - The NAE shall reside on the automation network and shall support a subnet of system controllers.
   3. User Interface - Each NAE shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.
      a. The web based UI software shall be imbedded in the NAE. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
      b. The NAE shall support a minimum of two (2) concurrent users.
      c. The web based user shall have the capability to access all system data through one NAE.
      d. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one NAE.
      e. Systems that require the user to address more than one NAE to access all system information are not acceptable.
      f. The NAE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NAE.
      g. Systems that support UI Graphics from a central database or required the graphics to reside on the user's personal computer are not acceptable.
      h. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:
         1) Configuration
         2) Commissioning
         3) Data Archiving
         4) Monitoring
         5) Commanding
         6) System Diagnostics
      i. Systems that require workstation software or modified web browsers are not acceptable.
      j. The NAE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.
   4. Processor - The NAE shall be microprocessor-based with a minimum word size of 32 bits. the NAE shall be a multi-tasking, multi-user, and real-time digital processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.
5. Memory - Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.

6. Hardware Real Time Clock - The NAE shall include an integrated, hardware-Based, real-time clock.

7. The NAE shall include troubleshooting LED indicators to identify the following conditions:
   a. Power - On/Off
   b. Ethernet Traffic - Ethernet Traffic/No Ethernet Traffic
   c. Ethernet Connection Speed - 10 Mbps/100 Mbps
   d. FC Bus - Normal Communications/No Field Communications
   e. Peer Communication - Data Traffic Between NAE Devices
   f. Run - NAE Running/NAE In Startup/NAE Shutting Down/Software Not Running
   g. Bat Fault - Battery Defective, Data Protection Battery Not Installed
   h. Fault - General Fault
   i. Modem RX - NAE Modem Receiving Data
   j. Modem TX - NAE Modem Transmitting Data

8. Communications Ports - The NAE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.
   a. USC port
   b. URS-232 serial data communication port
   c. RS-485 port
   d. Ethernet port

9. Diagnostics - The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.

10. Power Failure - In the event of the loss of normal power, the NAE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.
    a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
    b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

11. Certification - The NAE shall be listed by Underwriters Laboratories (UL).

12. Controller network - the NAE shall support the following communication protocols on the controller network:
   a. The NAE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
      1) A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
      2) The Conformance Statements shall be submitted 10 days prior to bidding.
      3) The NAE shall support a minimum of 50 control devices.
   b. The NAE shall support LonWorks enabled devices using the Free Topology Transceiver FTT 10.
      1) All LonWorks controls devices shall be LonMark certified.
      2) The NAE shall support a minimum of 64 LonWorks enabled control devices.
   c. The NAE shall support the Johnson Controls N2 Field Bus.
      1) The NAE shall support a minimum of 50 N2 control devices.
      2) The Bus shall conform to Electronic Industry Alliance (EIA) Standard RS-485.
      3) The Bus shall employ a master/slave protocol where the NAE is the master.
      4) The Bus shall employ a four (4) level priority system for polling frequency.
      5) The Bus shall be optically isolated from the NAE.
6) The Bus shall support the Metasys Integrator System.

2.3 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 by 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.

2.4 PERSONAL COMPUTER OPERATOR WORKSTATION (FACILITY OFFICE)

A. General: Provide an operator's workstation to access the BAS network.

B. Provide PC Compatible computer system configured for use with DDC system, Dell Inc. or approved equal with the following minimum features:
   1. Quad Core Intel® Core™ i7 920 processor
   2. 4.0 GB RAM memory
   3. 320 GB hard disk
   4. USB ports built-in
   5. DVD +/- RW 1-8X minimum CD-RV
   6. 22" LCD flat panel color monitor
   7. Microsoft USB mouse
   8. Microsoft Keyboard
   9. Software: Windows 7 Professional

C. Provide a color ink jet, multi-function, wireless printer, copier, fax and scanner equal to Lexmark S600. Printer shall print alarms, graphics and any other screen displays.

D. Network Connection: Graphical workstations shall allow for access to the BAS network through a pull-down menu approach using only a mouse. The keyboard shall be required only when entering text of for programming functions. The workstation shall be used as an interface to the BAS network and shall not be required to process any control or energy management algorithms nor manage any BAS network communications.
E. Provide context-sensitive help menus to provide instructions appropriate with operations and applications currently being performed.

F. Multiple user security levels shall be provided to allow for various degrees of system access and control. The system shall automatically generate a report of log-on/log-off time and system activity for each user. Provide automatic log-off capability to prevent unauthorized system use.

G. The workstation shall be provided with a key element display that records log-ons, log-offs, overrides, alarms and alarm acknowledgments.

2.5 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/°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. Precisions 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 product 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. CO₂ 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.

2.6 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 5psig, 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 2psig 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 bubbletight 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.


### 2.7 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 trough.

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.

2.8 AIR FLOW MEASURING STATION

A. Multi-point electronic thermistor probe suitable for duct or fan inlet airflow measurement with transmitter, equal to Ebtron Advantage II Gold Series. Provide aluminum alloy casing, ± 2% / ± .25% accuracy/repeatability and UL listed transmitter.

2.9 PRESSURE TRANSMITTERS/TRANSDUCERS:

A. Acceptable Manufacturers:
   1. Setra 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.
2.10 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.

2.11 DDC CONTROLLERS

A. The 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.

**2.12 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.

2.13 DYNAMIC COLOR GRAPHICS

A. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.

B. The graphics applications shall include a create/edit function and runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed.

C. The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.

D. Graphics runtime functions - A maximum of 16 graphic applications shall be able to execute at any one time on a user interface or workstation with 4 visible to the user. Each graphic application shall be capable of the following functions:
   1. All graphics shall be fully scalable.
   2. The graphics shall support a maintained aspect ratio.
   3. Multiple fonts shall be supported.
   4. Unique background shall be assignable on a per graphic basis.
   5. The color of all animations and values on displays shall indicate if the status of the object attribute.

E. Operation from graphics - It shall be possible to change values (setpoints) and states in system controlled equipment by using drop-down windows accessible via the pointing device.

F. Graphic editing tool - A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all animations, and defining all runtime binding.
   1. The graphic editing tool shall in general provide for the creation and positioning of point objects by dragging from tool bars or drop-downs and positioning where required.
   2. In addition, the graphic editing tool shall be able to add additional content to any graphic by importing backgrounds in the SVG, BMP or JPG file formats.

G. Aliasing - Many graphic displays representing part of a building and various building components are exact duplicates, with the exception that the various variables are bound to different field values. Consequently, it shall be possible to bind the value of a graphic display to aliases, as opposed to the physical field tags.

2.14 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 months from 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.

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.

3.2 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, 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, 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 2 and Smaller: Use dielectric unions.

C. Dielectric Fittings for 2-1/2 to NPS 4: Use dielectric flange kits.

D. Dielectric Fittings for 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. 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.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
   1. 3/4: Maximum span, 7 feet.
   2. 1: Maximum span, 7 feet.
   3. 1-1/2: Maximum span, 9 feet.
   4. 2: Maximum span, 10 feet.
   5. 2-1/2: Maximum span, 11 feet.
   6. 3 and Larger: Maximum span, 12 feet.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
   1. 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
   2. 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
   3. 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
   4. 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   5. 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   6. 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.

E. 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 WATER DRAINING

A. Provide 3/4” hose end gate valves at low points and bottom of each riser to drain HVAC water systems.

### 3.8 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.

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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 23.21.14

EXTERIOR AND UNDERGROUND CHILLED WATER DISTRIBUTION SYSTEMS

PART 1 – GENERAL

1.01 APPLICABLE STANDARDS: The standards listed herein by society name, codes, etc. form a part of this specification to the extent referenced. The publications of such references are referred to in the text by the basic designation only, i.e., ASTM, ASME, etc.

1.02 SCOPE: Provide a completely operational prefabricated and pre-insulated underground distribution system for chilled water supply and return as shown on the drawings and specified herein. The work shall include but not be limited to the following:

A. The Contractor shall be responsible for field verification and site surveying required for determining exact dimensions for ordering materials and completing the installation.
B. Submittal of technical product data, installation instructions, certifications and shop drawings as required herein.
C. Manufacture of the system in strict accordance with quality control and testing requirements as specified herein.
D. Shipment, handling, storage and installation of the system in strict accordance with manufacturers’ instructions and requirements as specified herein.
E. Coordination with all other trades in the installation of this and other work associated with the project.
F. Provision of accessories, valves, specialties, seals, materials, labor and equipment required for a complete and operational system installation in accordance with Contract.
G. Testing, repair or replacement of defective materials or work, retesting to meet the test requirements of this section.
H. Excavation, dewatering, shoring, backfill and compaction as specified herein, and in accordance with manufacturers’ instructions and job site requirements.

1.03 APPROVED MANUFACTURERS: Basis of design is Rovanco Insul-8 steel carrier pipe with HDPE jacket.

A. Alternate approved manufacturer is Perma-Pipe XTRU- Therm. All requirements specified herein must be met by the system provided.
B. Substitutions of insulation materials, jacket materials, carrier pipe types and schedules shall not be permitted. Changes in pipe routing shown on the drawings shall not be permitted. Specified insulation thickness and jacket thicknesses shall be minimum permitted.
C. Only systems meeting the requirements of this section and listed under approved manufacturer’s paragraph will be accepted.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer’s technical product data, installation instructions and details, and Field Service Technician’s qualifications.
B. Shop Drawings: Submit scaled layout drawings of the systems, including details of all components, fittings, expansion/contraction compensation, end seals, and anchors. Drawings shall clearly indicate pipe sizes, jacket sizes, slopes of horizontal runs, trench cross section details, and wall or floor penetration details. All dimensions shall be field verified prior to manufacturer of the system.
C. Record Drawings: Included installation details in the project Record Drawings upon completion of installation. Record Drawings shall reflect actual installed conditions of the systems in plan and elevations and shall accurately locate all system components.

D. Maintenance Data: Submit maintenance data for systems provided. Included this date with product, shop drawings, record drawings in an Owner’s maintenance manual.

PART 2 – PRODUCTS

2.01 GENERAL: The underground chilled water distribution system shall be a factory prefabricated and pre-insulated system consisting of carrier pipe, insulation and jacketing as specified, and supplied by an approved manufacturer listed herein.

2.02 System shall be designed for working pressures up to 150 psig and working temperature of 40° F, and shall meet the following requirements:

A. Carrier pipes shall be black steel, ASTM A53, Grade B, seamless, schedule 40 for sizes through 10” diameter; 0.375 inch wall thickness for sizes 12” and larger diameter.

B. Carrier pipe fittings shall be wrought steel, weld type, long radius, and shall match thickness of adjacent pipe. For pipe sizes less than 2.5” diameter, fittings shall be socket welded. For pipe sizes 2.5” and larger fittings shall be butt welded.

C. Insulation for pipe and fittings shall be polyurethane foam with the following characteristics: K factor of not greater than .15 at 50 degree F ambient temperature, minimum density of not less than 2 pounds per cubic foot, in conformance with MIL-I-24172, completely filling the annular space between carrier pipe and jacketing. Minimum insulation thickness will be in accordance with the following table.

D. Jacketing for all pipe and fittings shall be seamless, high density polyethylene (HDPE), conforming to ASTM D1248 and D3350, type III, category 5, Class C and grade P23/P34. Minimum jacket thicknesses and diameters shall be in accordance with the following schedule:

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>INSULATION THICKNESS</th>
<th>JACKET THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 in. and below</td>
<td>1.0 in.</td>
<td>.125 in.</td>
</tr>
<tr>
<td>6 in. thru 10 in.</td>
<td>2.0 in.</td>
<td>.150 in.</td>
</tr>
<tr>
<td>12 in thru 18 in.</td>
<td>2.0 in.</td>
<td>.200 in.</td>
</tr>
</tbody>
</table>

E. All fittings shall be factory prefabricated and pre-insulated at manufacturers’ plant. No insulation of fittings will be allowed on the job site. All factory fabricated jacket joints and miters for elbows, tees, anchors and accessories shall be HDPE butt fusion welded. The factory HDPE welding procedure and quality control method shall be submitted with product data submittals for approval.

F. After welding and testing of carrier pipes, field joint area shall be insulated with sectional urethane foam. No mixing, pouring or spraying of foam insulation shall be allowed at field joints. Sectional urethane foam insulated field joint shall be covered with a split HDPE rock shield of same thickness as adjacent jackets and the entire joint area covered with a polyethylene heat shrink cover, minimum 60 mils thickness.

G. End seals will be provided at all terminations of the pre-insulated system. End seals shall be pre-molded polyethylene shrink type.
PART 3 – EXECUTION

3.01 GENERAL: Installation of the prefabricated, pre-insulated systems shall be done in accordance with the following requirements and the manufacturer’s instructions.

3.02 EARTHWORK

A. Provide excavation, dewatering, backfilling, and shoring under this section. Comply with all local codes and safety ordinances related to this work.
B. Excavate trenches to the depths as indicated on the drawings, making allowance for 6” of bedding material. Grade the bottom of the trench to provide uniform beaming and support for the pipe. Remove shoring, bracing, support blocks and debris from the trench. Install a 6” layer of sand bedding material and hand compact to 90% modified proctor.
C. After placement of pipe back fill with sand or an approved sand-gravel mixture in 6” lifts to a distance of 12” above the top of the pipe casting or jacket. Hand compact each layer.
D. Place final backfill in one foot lifts. Final backfill material to be clean earth free of organic material, rocks, and foreign matter. Final backfill may be compacted using mechanical compaction equipment to 85% modified proctor.
E. Maintain minimum cover of 24” above top of pipe casting in grassed areas and 36” in paved areas and below sidewalks.

3.03 RECONDITIONING SURFACES

A. Unpaved surfaces shall be restored to their original condition and elevation. Sod or topsoil shall be carefully preserved and replaced after backfilling. Sod that is damaged shall be replaced.
B. Paved surfaces, sidewalks, gutters and curbs shall be patched or restored to an undisturbed condition.

3.04 WELDING: The contractor shall be solely and entirely responsible for the quality of system welding.

A. Qualification of welders, rules of procedure for qualification, and general requirements for fusion welding shall conform to applicable portions of ANSI 31.1 and AWS B3.0. All welds shall have 100% penetration. Each welder shall be examined at the job site by the Contractor to determine the ability of the welder to meet the qualifications required. The Contractor shall have available for review a listing of qualified welder’s names and corresponding code markings.
B. Field beveling and factory beveling may be by mechanical means or flame cut. For flame cut bevels, thoroughly clean surfaces of scale and oxidation just prior to welding. All beveling shall conform to ANSI B31.1 and AWS B3.0.
C. Use split welding rings for field joints on all pipe 2.5” and larger to assure proper alignment, complete penetration, and prevention of weld splatter reaching the interior of pipe. Make field joints for pipe less than 2.5” using welding sockets.
D. Test all welds in accordance with provisions of this section. Replace and re-inspect defective welds. Repairing defective welds by adding weld material over defect or by peening shall not be permitted.
E. Store electrodes in a heated dry area and keep free from moisture during fabrication operations.
F. For factory fabrications, all steel pipe and fittings shall be welded and tested in accordance with ANSI B31.1 Code for Pressure Piping. All steel pipe welders at the prefabrication plant shall be certified. Steel pipe welding procedures and certifications of welders are to be submitted with product data submittals.
3.05 TESTING

A. Carrier pipes shall be hydrostatically tested at 1.5 times working pressures or at 150 psig, whichever is greater, for a period of four hours. Visually inspect all joints for signs of leakage. Systems may be tested in stages, but every weld joint shall be tested.

B. Additionally, where piping crosses traffic thoroughfares and other areas subject to frequent vehicular or equipment loads, perform radiography for all field welds.

C. Designer shall be notified 48 hours prior to any test. Contractor shall submit test reports on every test indicating date of test, sections tested, beginning and ending times and beginning and ending pressures recorded.

END OF SECTION
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: 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°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 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.
2.6 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 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 (Not Applicable)

1.1 GENERAL
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 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:
   1. Angle or straight pattern.
   2. 250-psig pressure rating, cast-iron body, pump-discharge fitting.
   3. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
   4. 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 23.31.13
SHEET METAL DUCTWORK - LOW PRESSURE

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-fabricatedcouplings 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.

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 complying with Section 233300 "Air Duct Accessories."

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 Zone-Volume Air-Handling Units:
      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:
      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.

E. Outdoor-Air Ducts:
   1. Ducts Connected to Air-Handling Units:
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

SHEET METAL DUCTWORK - MEDIUM PRESSURE

PART 1 - GENERAL

1.1 DUCTWORK

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>
<thead>
<tr>
<th>Diameter or Minor Axis, Inches</th>
<th>0&quot; - 34</th>
<th>35&quot; - 59</th>
<th>60+</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.

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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. All exposed ductwork shall be fabricated from paint grip sheet metal.

B. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

C. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

D. 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.

E. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

F. 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.

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 FANS

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 PROPELLER FANS
   A. Twin City, Cook or approved equal.
   B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.
   C. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.
   D. Fan Wheel: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.
   E. Fan Drive: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
   F. Fan Drive:
      1. Resiliently mounted to housing.
      2. Statically and dynamically balanced.
      3. Selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
      4. Extend grease fitting to accessible location outside of unit.
      5. Service Factor Based on Fan Motor Size: 1.4.
      6. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
         a. Ball-Bearing Rating Life: ABMA 9, L_{10} of 100,000 hours.
      8. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
      9. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
      10. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
   G. Accessories:
      1. Heavy duty gravity backdraft damper.
      3. Wall Mounting Sleeve: Galvanized steel to match fan and accessory size.
      4. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

2.4 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 23.34.23
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 air flow 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
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 TERMINALS
A. CD-1: Provide Square Ceiling diffusers equal to Titus Omni or approved equal with round duct collar, square center plaque face panel with 360 degree air pattern, all aluminum construction with sliding radial damper, where indicated on the drawings. The back of the face panel shall have an aerodynamically shaped, rolled edge to ensure a tight horizontal discharge pattern. Frame to match ceiling type. Finish shall be baked on, off-white enamel.
B. SD-1: Provide linear slot ceiling & side wall diffusers equal to Titus ML-39 or approved equal at all locations designated by schedule on drawings. Diffusers to be complete with horizontal to vertical airflow pattern adjustment. Minimum lengths of continuous border sections to be as indicated. Diffuser shall be furnished in multiple sections and joined together end-to-end with alignment pins to form a continuous slot appearance. Slot width to be one-inch. Total number of slots required to be indicated on drawings. Finish to be clear anodized aluminum. Provide flanged border and concealed mounting. Internal airflow pattern adjustment mechanism to be flat black. Provide each diffuser with insulated plenum with round duct connection, Titus MPI-39.
D. RG-1: Provide aluminum construction 24x24 return register complete with opposed blade damper and 1/2" x 1/2" x 1" cube egg-crate grid. Finish shall be off-white, baked on enamel. Reference architectural ceiling plans for lay-in or surface mount frame requirements.
E. SR-2: Sidewall Return Registers (Scene Shop): Provide Ruskin ELF15J fixer louver face, 45 degree, steel with white finish for paint adhesion.

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.

2.6 AUTOMATIC CONTROL DAMPERS
   A. All automatic control dampers to be furnished by Control subcontractor and installed by this Contractor (except unit mounted dampers).
      1. Automatic control dampers to be low-leak, galvanized steel or aluminum construction parallel blade type, Ruskin Model CD36, Arrow Series 395, or approved equal.
      2. Dampers to be complete with minimum 4” deep, 16-gauge hat-shaped channel frame, minimum 16 gauge blades on maximum 6” centers, 1/2” diameter shafts, and corrosion resistant bearings.
      3. Dampers to have extruded vinyl blade seals and stainless steel or aluminum flexible metal compression type jamb seals to limit leakage to a maximum of ½% (maximum of 5.4 cfm/sq. ft. leakage for 48” x 48” size damper) when tested in accordance with AMCA Standard 500.
      4. Motor actuator to be oil immersed in gear train, 120- volt line voltage type with spring return to closed position on power interruption. Provide Honeywell Model M445/845, Barber-Colman MA-5210/5330 or approved equal complete with damper linkages.

2.7 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.

2.8 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.

2.9 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.

2.10 FLEXIBLE DUCT (NON-CRITICAL NOISE AREAS ONLY)
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.

2.11 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.

2.12 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 openin.

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 GAGES
   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 1 - GENERAL

1.1 SUMMARY
A. Section Includes: Listed double-wall vents.

PART 2 - PRODUCTS

2.1 DOUBLE WALL POSITIVE PRESSURE SYSTEM
A. Provide UL tested and listed double wall pipe and fittings suitable for forced/induced draft boilers.
B. Suitable for use with natural gas.
C. Maximum 1000 degrees F continuous operating temperature, or 1400 degrees F intermittent.
D. Inner Shell:
   1. 20 gauge 304 stainless steel for natural gas.
E. Outer shell: 24 gauge aluminum coated steel.
F. Shell Separation: 1 inch air space.
G. Minimum rated clearance to combustibles: 10 inches.
H. Couplings: Flanged containment band.
I. AMPCO Model VSI-2, Metalbestos Model PS, or approved equal.

PART 3 - EXECUTION

3.1 APPLICATION
A. Install double wall vent per manufacturer's installation instructions.

3.2 INSTALLATION OF LISTED VENTS
A. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.
B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.
C. Support vents at intervals recommended by manufacturer to support weight of vent and all accessories.
D. Lap joints in direction of flow.
E. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

END OF SECTION 23.51.23
SECTION 23.52.33
FORCED DRAFT GAS WATER TUBE BOILERS

PART 1 - GENERAL

1.1 SUMMARY
A. Provide Water Tube Boiler complete with all controls and accessories ready to operate on natural gas.

PART 2 - PRODUCTS

2.1 BOILER
A. Provide water tube type equal to Bryan RV Series or approved equal.
B. Design working pressure 150 psi.
C. The boiler shall be manufactured in accordance with ASME Boiler and Pressure Vessels Code.

2.2 VESSEL AND TUBE CONSTRUCTION
A. The boiler shall be constructed on a heavy steel frame. The boiler pressure vessel shall be provided with adequately sized upper and lower drums. A minimum of two downcomers shall be provided and shall be located inside furnace chamber to maximize proper thermal internal water circulation. No external water circulation source shall be required. Steel water tubes are to be 1 1/2" O.D., .095 wall thickness, six-ass, flexible serpentine bend design, not subject to thermal shock damage. Individual water tubes shall be easily removable and replaceable without either welding or rolling. The boiler shall have no more than two tube configurations. The boiler shall be furnished with an adequate number of tappings and inspection openings to facilitate internal boiler inspection and cleaning.

2.3 BOILERS TRIM
A. Provide the following controls and trim:
   1. ASME Safety Relief Valve.
   2. Low water cut off.
   3. High limit safety control.
   4. Water temperature control operator.
   5. Drain Valve.
   6. Combination thermometer and pressure gauge.

2.4 BOILER BURNER AND CONTROLS
A. Boiler shall be furnished with a UL listed forced draft flame retention gas burner. Burner shall be complete with integral motor and blower for supplying sufficient combustion air with vent conditions.
B. Provide boiler with the following controls:
   1. Manual gas shut off valve
   3. High and low gas pressure switches.
   4. Gas pilot shut off and solenoid valves.
   5. Gas pilot ignition assembly with ignition transformer.
   6. Pilot and main gas pressure regulators.
C. Provide burner mounted control panel complete with the following:
   1. Two indicator lights - power and fuel
   2. Air Safety Switch
   3. Fused on/off switch
   4. Electronic combustion safety control
2.5 JACKET CONSTRUCTION
A. Provide boiler with complete metal jacket, 16 gauge, zinc-coated rust resistant steel casing, finished with a suitable heat resisting paint and shall be constructed on a structural steel frame and properly insulated with no less than 1 1/2" fiberglass insulation. Complete jacket and insulation shall be easily removable and reinstalled. The boiler shall incorporate individually removable jacket doors, with handles providing easy access to combustion chamber and access panels. The entire tube area shall be easily accessible for fireside cleaning.
B. All appropriate controls where possible, shall be mounted on boiler front.
C. A tube removal and replacement shall be demonstrated at time of start-up. Demonstration time not to exceed 40 minutes.
D. The boiler vessel shall be warranted for 25 years against thermal shock on a non-pro-rated basis.

2.6 CONTROL SYSTEM
A. Building Automation System Interface: Factory install hardware and software to enable system to monitor, control, and display boiler status and alarms.
   1. Hardwired I/O Points:
      b. Control: On/off operation, hot-water-supply temperature set-point adjustment.
   2. Communication Interface: BACnet communication interface shall enable control system operator to remotely control on/off and capacity of boiler and monitor the boiler operation from an operator workstation. Control features are available, and monitoring points are displayed locally at boiler control panel through the interface.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install boilers in accordance with NFPA 54, ASME, local codes, and manufacturer's instructions, and Factory Mutual requirements.
B. Boiler and accessories shall be installed and piped per manufacturer's recommendations and under his supervision. Drain valves on boiler shell, feedwater columns, condensate receivers, and boiler feed unit tanks shall be piped to the nearest drain, full size of the connection. Relief valves and vents shall be piped to outside the building using either the connection size or the size shown on the drawings, whichever is the larger. Ells on relief lines turning up through the roof shall be drip pan ell. Pipe gas vent connections on gas controls to outside of the building.
C. Boilers shall receive factory start-up supervision tests to check construction, operation, and function of controls and to ensure proper preparation for use.
D. Assemble and install boiler trim, components, and accessories that are not factory installed.
E. Install control and electrical devices furnished with boiler that are not factory mounted.
F. Install control and power wiring to field-mounted control and electrical devices furnished with boiler that are not factory installed.

3.2 START-UP
A. Check operation of safety valves at 20 psi above schedule operation pressure.
B. Adjust firing equipment.
C. Operate boilers at 1/3, 2/3 and full loads.
D. Take readings every half hour for 3 hours for the following:
   1. Stack temperature.
   2. Percent carbon dioxide and oxygen.
E. Adjust fuel/air mix to maximum combustion efficiency.

### 3.3 OPERATING DEMONSTRATION

A. Demonstrate to Owner the operation of the system over entire range

### 3.4 FLUE CONNECTIONS

A. Boiler Flue Venting:
   1. Connect full size to boiler connection. Comply with requirements in Section 235123 "Gas Vents."

   B. Connect breeching to full size of boiler outlet. Comply with requirements in Section 235116 "Fabricated Breechings and Accessories".

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**END OF SECTION 23.52.33**
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. 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.

D. 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.

E. 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.

F. Compressor Motor Controllers:
   1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.

G. 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.

H. 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.

I. Air-Cooled Condenser:
   1. Plate-fin coil with integral subcooling on each circuit, rated at 450 psig.
      a. Construct coils of copper tubes mechanically expanded to aluminum fins.
      b. Hail Protection: Provide condenser coils with louver, 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.

J. 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.

K. 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

L. 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.

M. 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 single zone variable volume air handling unit and variable volume air handling units as scheduled.

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 234110 "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 high efficiency (MERV 13) 12" thick pleated disposable type cartridge filters equal to Farr Riga-Flo 100.
      5. Provide a factory mounted Dwyer inclined tube draft gage across each filter section and mark gage to indicate design clean and dirty loading conditions.
      6. 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
100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017

SECTION 23 74 13

MODULAR, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.01 PERFORMANCE

A. Certify unit components in accordance with ARI Standard 430 as applicable.

B. Certify coils in accordance with ARI Standard 410.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. JCI, Trane, Daiken.

2.02 CASING CONSTRUCTION

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.

2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.

3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.

4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

5. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.

6. Access to filters, dampers, cooling coils, exhaust fans, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
7. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.

8. Units with cooling coils shall include double sloped 304 stainless steel drain pans.

9. Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.

10. Unit shall include lifting lugs on the top of the unit.

2.03 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.

2.04 COOLING COILS

A. Chilled Water Cooling Coil:

1. Coils 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.

2.05 HOT WATER PRE-HEAT AND RE-HEATING COILS:

A. 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.

B. Provide coils with a maximum working pressure of 175 psig at 200 degrees F.

C. Provide circuited drainable coils with vent connection at highest point and drain connection at lower point.
2.06 FILTERS

A. Unit shall include 2 inch thick, pleated panel filters with an ASHRAE efficiency of 35% and a MERV rating of 8, upstream of the cooling coil.

B. Unit shall include a clogged filter switch.

2.07 OUTSIDE AIR/ECONOMIZER

A. Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq. ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511. Damper assembly shall be controlled by spring return enthalpy activated fully modulating actuator. Unit shall include outside air opening bird screen, outside air hood, and barometric relief dampers.

2.08 ADDITIONAL SECTIONS

A. Double Wall Filter Section:

1. 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.

2. Provide medium efficiency (MERV 8), 2” thick pleated disposable type panel filters equal to Farr 30/30.

3. Provide a factory mounted Dwyer inclined tube draft gage across each filter section and mark gage to indicate design clean and dirty loading conditions.

4. 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 coil access section for placement at chilled water coil, hot water coil, filter mixing section, energy recovery wheel, and fan. Access doors shall be located on both sides of sections. Doors shall be full sized, hinged, latched, and double wall.

D. Provide unit manufactured, insulated piping vestibules for chilled water coil, pre-heat hot water coil and re-heat hot water coils.

2.9 DAMPERS

A. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with motorized damper filter.

B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
1. Damper Motor: Modulating with adjustable minimum position.

2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1, with bird screen and hood.

### 2.10 AHU CURBS

A. Curbs shall be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the unit and mounted on the curb immediately before mounting of the unit.

B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A.
   a. Materials: ASTM C 1071, Type I or II.
   b. Thickness: 2 inches.

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
   a. Liner Adhesive: Comply with ASTM C 916, Type I.
   b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
   c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
   d. Liner Adhesive: Comply with ASTM C 916, Type I.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

A. Equipment Mounting:

1. Install outdoor air handling units on factory roof curb.

B. Curb: Install in accordance with manufacturer’s instructions.

C. Unit Support: Install unit level on curb. Secure AHU’s to equipment rails with anchor bolts.

D. Install condensate drain, minimum connection size, with trap and indirect connection to nearest area drain.

E. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
1. Connect supply ducts to AHU's with flexible duct connectors specified in Section 233713 "Sheet Metal Specialties."

2. Install return and supply isolation plenums.

### 3.02 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:

1. Reference Section 230593 "Testing, Adjusting, and Balancing for HVAC".

### 3.03 CLEANING AND ADJUSTING

A. 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 site during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing AHU’s and air-distribution systems, clean filter housings and install new filters.

END OF SECTION
SECTION 23.82.19
FAN COIL UNITS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes vertical fan coil units, horizontal concealed fan coil units and horizontal exposed cabinet 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 HORIZONTAL FAN COIL UNITS
A. Provide JCI, Trane or approved equal.
B. Fabricated of heavy gauge panels insulated with antimicrobial elastomeric closed cell foam insulation.
C. All concealed units shall have a minimum 1-1/4 inch duct collar on the supply discharge. Provide return air plenum section with a 1-inch duct collar. Unit shall have a hinged bottom access panel.
D. All exposed units shall have a power coated finish. All exterior panels shall be finished on both sides with an anodic acrylic power paint of the standard factory color. Provide side and bottom access panels with quick open fasteners. Provide double deflection discharge grille and a bottom return grille.
E. 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.
F. Provide primary drain pan constructed of heavy gauge type 304 stainless steel. Stainless steel drain pans shall be externally insulated. Provide a condensate overflow switch in the primary drain pan.
G. 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.
H. Provide 1-inch pleated throwaway filter.
I. Provide piping package including 2-way modulating control valve, isolation ball valves, unions and pressure-temperature ports.
J. Thermostat shall be unit mounted with integral three speed fan switch.
K. Provide horizontal units with hanger suspension.
L. 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:
   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 23.84.15
ELECTRIC STEAM HUMIDIFIERS

PART 1 - GENERAL

1.01 EQUIPMENT

A. Provide Dri-Steam or approved equal electric humidifier complete with the following:

1. Evaporating reservoir: fabricated of stainless steel, with gasket sealing capable of operating at designed pressure without steam or water leaks.

2. Immersion heaters: stainless steel clad and sized to produce required steam flow. Heaters shall be easily removable to facilitate cleaning or inspection. Heaters shall contract and expand to allow scale to flake off as it accumulates.


4. An adjustable surface water skimmer.

5. A removable access pane; to permit periodic scale removal and inspection.

6. A UL listed control panel to include all operating controls, magnetic contactor(s), fused control circuit transformer, numbered terminal block and heater fuses.

7. A solid state electronic level control module to provide automatic refilling, resetting, low water cutoff, and surface water skimming.

8. Adjustable timer and drain valve for automatic drain and flush at timed intervals.


11. Stainless steel dispersion tube and steam hose.

12. Support legs

13. Factory insulate unit with minimum ¾ inch thick insulation with jacket.


15. Return air duct humidistat.

16. Space humidistat

17. Supply duct high limit humidistat.

18. Solid state power (SCR) controller to modulate humidifier output from 0 to 100% capacity.

19. Multiple stage electronic controller mounted in control cabinet to stage humidifier output from 0 to 100 percent capacity.

PART 2 – PRODUCTS – NOT APPLICABLE

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install humidifiers in strict accordance with manufacturers’ published installation instructions.

3.02 START-UP AND TESTING

A. Start-Up and test humidifiers and humidistats for satisfactory operation. Check to ensure that humidifier responds to humidistat over selected ranges. Check high limit humidistat for proper operation. Instruct owner in system operation.
PART 1 – GENERAL

1.01 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, and cabling.
      5. Power wiring for equipment furnished under Division 21, 22 and 23.
      6. Fire Alarm System
      7. Field Lighting System

1.02 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.

1.03 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.

1.04 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.

1.05 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
- Field Lighting

**PART 2 - PRODUCTS (Not used)**

**PART 3 - EXECUTION**

**3.01 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.

**3.02 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

1.01 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.

1.02 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

2.01 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

3.01 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.

3.02 CUTTING AND PATCHING
   A. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

3.03 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.
3.04 **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.

3.05 **IDENTIFICATION OF EQUIPMENT**
   A. Equipment shall be identified in accordance with Section 26.05.53, “Electrical Identification.”

3.06 **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.

3.07 **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.

3.08 **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.

3.09 **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

1.01 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.

1.02 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

2.01 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): Aflex, 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): Aflex, Electroflex, or approved equal.

2.02 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

3.01 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 1/2” unless otherwise required.

K. Leave one #10 AWG or equivalent 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.

3.02 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.
PART 1 - GENERAL

1.01 WORK INCLUDED
   A. Wire and cable for all service, feeders, branch circuits, and instrument and control wiring rated 600 volts and below.

1.02 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

2.01 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

3.01 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.

3.02 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
PART 1 – GENERAL

1.01 WORK INCLUDED
   A. Grounding electrodes and conductors.
   B. Equipment grounding conductors.
   C. Bonding.

1.02 PERFORMANCE REQUIREMENTS
   A. The grounding system to earth resistance shall be less than 5 ohms.

1.03 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

2.01 MANUFACTURERS
   A. Manufacturers shall be Burndy, T&B, or approved equal.

2.02 GROUNDING ELECTRODES
   A. Ground rods shall be copper clad steel with minimum dimensions of ¾ inch diameter by 10 feet long.

2.03 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.

2.04 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

2.05 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

3.01 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.

3.02 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.

3.03 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
PART 1 – GENERAL

1.01 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.

1.02 QUALITY ASSURANCE
   A. Electrical Component Standard: Components and installation shall comply with the National Electrical Code.

PART 2 – PRODUCTS

2.01 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 Mgf. Co., Thomas & Betts Corp., or approved equal.

2.02 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.

2.03 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.
2.04 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

3.01 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

1.01 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.

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

1.01 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

2.01 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.

2.02 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, preprinted, 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.
2.03 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

3.01 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
PART 1 – GENERAL

1.01 WORK INCLUDED
A. This section includes circuit breakers and fuses.

1.02 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 compiled by Contractor after motors have been installed. Arrange list to demonstrate selection of heaters to suit actual motor nameplate full load currents.

1.03 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

2.01 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.

2.02 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.

2.03 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.

2.04 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.

2.05 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

3.01 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.

3.02 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.
PART 1 GENERAL

1.01 SUMMARY

A. Work in this section includes the installation of the Performance Lighting, Power, and Controls System and provision of supporting conduit, wire and standard backboxes.

B. Section Includes

1. Materials, components, modifications, assemblies, equipment and services as specified herein. These include, but are not limited to:
   a. Verification of site dimensions and conditions.
   b. Submittals as required by the Contract Documents.
   c. Engineering as required by the Contract Documents.
   d. Manufacture of equipment and systems as required by the Contract Documents.
   e. Scheduling, sequencing and coordination with other trades.
   f. Review of shop drawings provided by related sections
   g. Testing and demonstration of equipment and systems as specified herein and elsewhere in the Contract Documents in coordination with related sections

2. Coordination with the 11 61 61 Contractor as specified in Section 11 61 61 for a complete performance lighting power and controls system.

3. Power distribution devices, conduit and wire as required in this Section and related Specification Sections listed herein.

4. Disconnects, power feeds as required for performance lighting power panels.

5. Standard backboxes as noted in the contract documents. Specialized boxes are excepted from this.

6. This specification is considered as an outline form and other appurtenances that may be required for the efficient and safe operation of the performance lighting power, and control systems specified in this section will be furnished under Section 11 61 61, the same as if specified herein.

C. Products Installed under this section and furnished under 11 61 61:

1. Backboxes for faceplates furnished under 11 61 61. Standard boxes are excepted from this.

2. Lighting receptacles, Connector Strips, and Faceplates carrying 100V or above.

3. Busway

4. Dimmer Racks

5. Relay Panels.


7. Panel Board surge suppression.

8. Multipole contactors

9. Company Switches


1.02 DEFINITIONS

A. The term “furnish” means to supply and deliver to the job site, ready for unloading, unpacking, assembly, installation, and similar operations.

B. The term “install” is used to describe operations at the job site including the actual anchoring, applying, assembly, cleaning, curing, cutting, erection, finishing, patching, placing, protecting, pulling, terminating, unloading, unpacking, working to dimension, and similar operations that will render the systems complete and ready for the intended use.

C. The term “provide” means to furnish and install.

D. Performance Lighting Power Panel: A dimmer rack, relay, panel, motorized breaker panel or contactor panel controlled by the performance lighting system.
E. Data Communications: Signals that provide control and feedback communications between devices in the system.

1.03 SYSTEM DESCRIPTIONS

A. The performance lighting power, and controls system consists of wiring devices, both low and line voltage, performance power panels, lighting network control rack and remote consoles.
   1. Line voltage feeds to the distributed circuits require a dedicated neutral per circuit.
B. The DMX 512 control signal will be generated by various consoles and devices, and is connected to the performance power panels via conduit runs and low voltage cables.
C. The Ethernet control signal will be generated by various consoles and devices, and is connected to the hub via conduit runs and low voltage cables.
D. Equipment will be the coordinated and the system integrated by the 11 61 61 Contractor in coordination with the Division 26 Contractor.
E. The specified performance lighting power, and controls components are fully described in the Contract Documents. Complete technical data is also available from the manufacturer. Catalog numbers are those shown on Manufacturer’s data sheets and drawings unless otherwise noted.

1.04 SUBMITTALS

A. Bid Submittals
   1. The Division 26 Contractor will examine drawings prior to submitting his bid. He will note adverse conditions to be overcome or circumvented, and favorable conditions to be taken advantage of. Submittal of a bid will indicate that the Division 26 Contractor has full knowledge of the problems involved in the work and that he has taken these into consideration in computing his bid.
   2. The Division 26 Contractor will bid on installation of the performance lighting power and control system as specified in 11 61 61 and any additional materials required to implement the system such as conduit, panel boxes and wire as specified in the Contract Documents.
   3. In addition to the submittals required under the general conditions of these specifications, bidders are required to furnish supporting documents as noted below in order for their bids to be considered.
   4. The Owner reserves the right to waive formalities, to be sole judge of quality and equality of the several bid proposals, and reserves the right to reject any and all bids.

1.05 QUALITY ASSURANCE

A. Supplementary:
   1. Secure equipment, except portable equipment, firmly in place. Mount components rigidly, except where resilient isolation is required. Design and provide fastenings and supports adequate to support their loads with a safety factor of at least three.
   2. Clearly mark switches, jacks, outlets, cables, connectors, etc. logically and permanently during fabrication and installation.
   3. Where many cables are run in close proximity color code by function in a logical manner.
   4. Take necessary precautions to prevent and guard against electromagnetic, electrostatic and radio frequency interference.
   5. Exercise care in wiring, so as to avoid damage to the cables and to the equipment. Between racks, cabinets, consoles or modules insure cables are well-supported, neatly laced and dressed. Make joints and connections with mechanical connectors approved by the Consultant.
   6. When cable is surface mounted and crossing through fire walls, use the equivalent fire rated plenum cable to the specified cable type.
   7. Label terminal strips, punch blocks, wire and cables in a permanent and logical manner with a unique number on each end of cable runs.
   8. Final location of equipment is as shown on the Drawings, located in the field by the Architect or as shown on supplementary drawings prepared by the Consultant.
1.06 WARRANTY
A. In addition to manufacturer's warranties, warrant provided systems and equipment to be free of defective components, faulty workmanship or improper adjustment for a period of two years from the date of building acceptance. Paint and exterior finishes are excluded. Equipment supplied under 11 61 61 excluded.
B. In addition to manufacturer's warranties, warrant installation to be free of defective components, faulty workmanship or improper adjustment for a period of two years from the date of building acceptance.
C. Replace items showing evidence of defective materials or workmanship (including installation workmanship) within thirty (30) days after notification. Make replacements without cost.
D. Rectify conditions that might present a hazard to human life, well-being and or property within 48 hours of notification.

1.07 PROJECT CONDITIONS
A. Questions requiring clarification of the specifications are addressed to the Architect.
B. Provide continuous liaison with the 11 61 61 Contractor during demolition and construction, and coordinate delivery schedules and installation of equipment with related trades.

1.08 PRODUCT HANDLING AND STORAGE
A. The Division 26 Contractor will make good or replace work, materials and equipment which have become contaminated, stolen, marred otherwise damaged, as directed by the Consultant and at no cost once the equipment has been accepted by the Division 26 Contractor.
B. Equipment will remain the responsibility of the Division 26 Contractor until building acceptance.

PART 2 PRODUCTS

2.01 MATERIALS
A. Materials as specified under Division 26.

PART 3 EXECUTION

3.01 DELIVERY
A. Materials within this contract will be delivered by the Division 26 Contractor to the project site. Performance lighting power, and controls system equipment shall be delivered by the 11 61 61 Contractor.
B. Equipment furnished under Division 11 61 61 will become the responsibility of the Division 26 Contractor at such time that the Division 26 Contractor takes possession of the equipment from the 11 61 61 Contractor.
1. At this time the Division 26 Contractor will document the exact condition, breakage or damage evident in the equipment.
2. Exact quantities will be documented.
3. Any discrepancies in the quantities and any damage or unsuitability of the product for the application will be provided in writing to the 11 61 61 Contractor upon transfer of the equipment.
4. Acceptance of the equipment verifies proper physical condition of the product. Electrical functionality is not implied at acceptance and is not the responsibility of the Division 26 Contractor.
5. The 11 61 61 Contractor will be present at the time of transfer to coordinate and expedite this action. The 11 61 61 Contractor shall be given a two week minimum lead time prior to this meeting.

1.01 LOW VOLTAGE CONDUIT SYSTEM
A. Observe conduit separation requirements indicated in the contract documents.
B. Provide trade size 3/4" conduit, unless otherwise noted.

C. Provide a complete, continuous and clean conduit system including all conduits, conduit supporting means, all electrical boxes and enclosures, etc, and all connections to terminal cabinets, pull boxes, SVC panels, and receptacles.

D. All conduit shall be clean and free of burrs, nicks, etc. Ream all conduit ends to prevent damage to cables.

E. Conduit runs shall not exceed 180 degrees of bends between pull boxes. If a run exceeds 180 degrees of bends insert a pull box in an accessible location.

F. Cable runs between documented terminal points (inclusive of inserted pull boxes) shall not exceed 250’ (75m).

G. Provide nylon pull cord in all conduit runs, point to point.

H. Non-metallic conduit is considered free air and separations for free air installation are required.

I. Sound systems create significant amounts of low frequency energy which vibrates everything in the space. Unrestrained metal to metal contact will buzz. The contractor will install devices in a fashion that eliminates buzzing due to unrestrained metal to metal contact.
   1. Where metallic conduits pass through metal gasket the opening to eliminate metal to metal contact.
   2. Where metallic conduit comes in contact with metal mechanically fasten the conduit to the metal.
   3. Where 2 metallic conduits cross and come in contact mechanically fasten conduits together.
   4. Where 2 metallic devices come in contact either mechanically connect the devices or install non-metallic gasketing between the devices mechanically affixing the gasket to one of the devices.
   5. Where conduit is tied directly to an equipment rack employ an isolation bushing to eliminate continuity between the conduit and the equipment rack. Ground the equipment rack with a dedicated ground wire tied back to ground at the associated panel board.

J. Mark the interior of the boxes with the box number to facilitate identification.

3.02 SUPERVISION OF INSTALLATION

A. The 11 61 61 Contractor will provide instruction and supervision to the Division 26 Contractor as it pertains to the installation of these systems. Provide the necessary personnel for coordination meetings and site visits prior to installation of systems.

3.03 SYSTEM COMMISSIONING

A. At no time will the equipment furnished under Section 11 61 61 be energized prior to the 11 61 61 Contractor authorized commissioning.

B. The Division 26 Contractor will notify the 11 61 61 Contractor within at least two weeks time for system commissioning.

C. The Division 26 Contractor will confirm in writing that the following conditions have been met prior to scheduling system commissioning
   1. Arrangements will be made for access to equipment and terminations. Scaffolding, lifts or any other OSHA approved method will be acceptable.
   2. Power Panels will be installed and wired.
   3. Distribution equipment will be completely installed.
   4. Continuity checks for the entire system will have been performed and failures remedied.

D. At the time of commissioning the Division 26 Contractor will provide a representative who is has full working knowledge of the system, device placement and job conditions. This representative will be on-site throughout the commissioning process and will coordinate with, and aid, the 11 61 61 Contractor to expeditiously commission the system.
3.04 INSPECTION AND TESTING

A. Field Check-out & Final Approvals. After the system is commissioned and functions in accordance with the contract documents in the opinion of the Division 26 Contractor and the 11 61 61 Contractor, the Design Consultant will inspect and test the system.

B. Make necessary arrangements for parties concerned to be present, by scheduling such inspection in a manner acceptable to the Design Consultant and give a minimum of 14 days notice.

C. A representative from the Division 26 Contractor, the 11 61 61 Contractor and the Design Consultant will be present at the test.

D. Furnish equipment and instruments necessary for testing the complete wiring system during the progress of the work as well as after installation. Tests shall be demonstrated to the satisfaction of the designer. Tests include the following:
   1. Circuits are continuous and free from short circuits.
   2. Circuits are free from unspecified grounds.
   3. Circuits are properly connected in accordance with the applicable wiring diagram.
   4. Voltage drop at each end of the circuit with a 2000 watt load.
   5. Low voltage circuits complying to industry standards.

E. Any defects will be repaired at once and the tests re-conducted.

3.05 RECORD DRAWINGS & OPERATION MANUAL

A. The Division 26 Contractor will provide three (3) copies of black and white prints on the system corrected in red to indicate changes made during construction.

END OF SECTION 26 09 61
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PART 1 GENERAL

1.01 SUMMARY

A. Work in this section includes the installation of the electrical components of Performance Machinery, and provision of supporting conduit, wire and standard backboxes.

B. Section Includes

1. Materials, components, modifications, assemblies, equipment and services as specified herein. These include, but are not limited to:
   a. Verification of site dimensions and conditions.
   b. Submittals as required by the Contract Documents.
   c. Engineering as required by the Contract Documents.
   d. Manufacture of equipment and systems as required by the Contract Documents.
   e. Scheduling, sequencing and coordination with other trades.
   f. Review of shop drawings provided by related sections.
   g. Testing and demonstration of equipment and systems as specified herein and elsewhere in the Contract Documents in coordination with related sections.

2. Coordination with the 11941 Contractor as specified in Section 11941 for the control and power system of an Orchestra Pit Lift system.

3. Coordination with the 11063 Contractor as specified in Section 11063 for the control and power system of Curtain Machines.

4. Coordination with the 11065 Contractor as specified in Section 11065 for the control and power system of a Powered Rigging System.

5. Coordination with the 11067 Contractor as specified in Section 11067 for the control and power system of a Mechanized Fire Curtain.

6. Power distribution devices, conduit and wire as required in this Section and related Specification Sections listed herein.

7. Disconnects, power feeds as required for the equipment.

8. Standard backboxes as noted in the contract documents. Specialized boxes are excepted from this.

9. This specification is considered as an outline form and other appurtenances that may be required for the efficient and safe operation of the mechanical systems specified in this section will be furnished under Division 16, the same as if specified herein.

C. Products Installed under this section and furnished under sections indicated above:

1. Specialty backboxes and enclosures furnished under the sections indicated above. Standard boxes are excepted from this.

2. Motor control panel enclosures.

3. Receptacles, wireways, and faceplates carrying 100V or above.

4. Control wireways.

5. Multiconductor cable furnished under 11941 for the purpose of providing power and control from the floor to the lift platform.

6. Control wiring and cable.

1.02 DEFINITIONS

A. The term “furnish” means to supply and deliver to the job site, ready for unloading, unpacking, assembly, installation, and similar operations.

B. The term “install” is used to describe operations at the job site including the actual anchoring, applying, assembly, cleaning, curing, cutting, erection, finishing, patching, placing, protecting, pulling, terminating, unloading, unpacking, working to dimension, and similar operations that will render the systems complete and ready for the intended use.
C. The term “provide” means to furnish and install.

1.03 SYSTEM DESCRIPTIONS

A. The performance mechanized lift system consists of motor control and safety devices designed to provide safe operation of the orchestra pit lift platform.

B. The performance powered rigging system includes electro-mechanically operated equipment assemblies, systems and components required for locating theatrical equipment in variable vertical and horizontal planes.

C. The mechanized fire curtain system is designed so as to intercept hot gases, flames and smoke between the stage and the auditorium seating area. A component of this is a mechanically operated winch that raises and lowers this curtain in non-emergency situations.

D. Curtain machines include electro-mechanically operated equipment assemblies, systems, and components required for locating performance and acoustical drapes in variable horizontal planes.

E. Components of each of these systems include, but are not limited to motor control systems, occupant sensing and notification systems, emergency stop systems, and local and remote controls.

F. Equipment will be coordinated and the system integrated by the contractors indicated above in coordination with the Division 16 Contractor.

G. The specified components are fully described in the Contract Documents. Complete technical data is also available from the manufacturer. Catalog numbers are those shown on Manufacturer’s data sheets and drawings unless otherwise noted.

1.04 SUBMITTALS

A. Bid Submittals

1. The Division 16 Contractor will examine all drawings, including those related to the performance systems, prior to submitting his bid. He will note adverse conditions to be overcome or circumvented, and favorable conditions to be taken advantage of. Submittal of a bid will indicate that the Division 16 Contractor has full knowledge of the problems involved in the work and that he has taken these into consideration in computing his bid.

2. The Division 16 Contractor will bid on installation of the electrical components of the performance systems noted above and any additional materials required to implement the system such as conduit, panel boxes, and wire as specified in the Contract Documents.

3. In addition to the submittals required under the general conditions of these specifications, bidders are required to furnish supporting documents as noted below in order for their bids to be considered.

4. The Owner reserves the right to waive formalities, to be sole judge of quality and equality of the several bid proposals, and reserves the right to reject any and all bids.

1.05 QUALITY ASSURANCE

A. Supplementary:

1. Secure equipment, except portable equipment, firmly in place. Mount components rigidly, except where resilient isolation is required. Design and provide fastenings and supports adequate to support their loads with a safety factor of at least three.

2. Clearly mark switches, jacks, outlets, cables, connectors, etc. logically and permanently during fabrication and installation.

3. Where many cables are run in close proximity color code by function in a logical manner.

4. Take necessary precautions to prevent and guard against electromagnetic, electrostatic and radio frequency interference.

5. Exercise care in wiring, so as to avoid damage to the cables and to the equipment. Between racks, cabinets, consoles or modules insure cables are well-supported, neatly laced and dressed. Make joints and connections with mechanical connectors approved by the Consultant.

6. When cable is surface mounted and crossing through fire walls, use the equivalent fire rated plenum cable to the specified cable type.
7. Label terminal strips, punch blocks, wire and cables in a permanent and logical manner with a unique number on each end of cable runs.
8. Final location of equipment is as shown on the Drawings, located in the field by the Architect or as shown on supplementary drawings prepared by the Consultant.
9. Install control system wiring which is continuous between terminations. Employ no splices for entire cable length.

1.06 WARRANTY
A. In addition to manufacturer's warranties, warrant provided systems and equipment to be free of defective components, faulty workmanship or improper adjustment for a period of two years from the date of Owner's acceptance. Paint and exterior finishes are excluded. Equipment supplied under Division 11 excluded.
B. In addition to manufacturer's warranties, warrant installation to be free of defective components, faulty workmanship or improper adjustment for a period of two years from the date of Owner's acceptance.
C. Replace items showing evidence of defective materials or workmanship (including installation workmanship) within thirty (30) days after notification. Make replacements without cost to the Owner.
D. Rectify conditions that might present a hazard to human life, well-being and or property within 48 hours of notification.

1.07 PROJECT CONDITIONS
A. Questions requiring clarification of the specifications are addressed to the Architect.
B. Provide continuous liaison with the Contractors listed above during demolition and construction, and coordinate delivery schedules and installation of equipment with related trades.

1.08 PRODUCT HANDLING AND STORAGE
A. The Division 16 Contractor will make good or replace work, materials and equipment which have become contaminated, stolen, marred otherwise damaged, as directed by the Consultant and at no cost to the Owner once the equipment has been accepted by the Division 16 Contractor.

PART 2 PRODUCTS
2.01 MATERIALS
A. Materials as specified under Division 16.

PART 3 EXECUTION
3.01 DELIVERY
A. Materials within this contract will be delivered by the Division 16 Contractor to the project site.
B. Equipment furnished by the contractors indicated above will become the responsibility of the Division 16 Contractor at such time that the Division 16 Contractor takes possession of the equipment.
1. At this time the Division 16 Contractor will document the exact condition, breakage or damage evident in the equipment.
2. Exact quantities will be documented.
3. Any discrepancies in the quantities and any damage or unsuitability of the product for the application will be provided in writing to the Division 11 contractor upon transfer of the equipment.
4. Acceptance of the equipment verifies proper physical condition of the product. Electrical functionality is not implied at acceptance and is not the responsibility of the Division 16 Contractor.
5. The Division 11 Contractor will be present at the time of transfer to coordinate and expedite this action. The Division 11 Contractor shall be given a two week minimum lead time prior to this meeting.
3.02 SUPERVISION OF INSTALLATION

A. The Division 11 contractor will provide instruction and supervision to the Division 16 Contractor as it pertains to the installation of these systems. Provide the necessary personnel for coordination meetings and site visits prior to installation of systems.

3.03 SYSTEM COMMISSIONING

A. At no time will the equipment furnished under the contractors indicated above be energized prior to their authorized commissioning.

B. The Division 16 Contractor will notify the Division 11 Contractor within at least two weeks time for system commissioning.

C. The Division 16 Contractor will confirm in writing that the following conditions have been met prior to scheduling system commissioning
   1. Arrangements will be made for access to equipment and terminations. Scaffolding, lifts or any other OSHA approved method will be acceptable.
   2. Distribution equipment will be completely installed.
   3. Continuity checks for the entire system will have been performed and failures remedied.
   4. Low voltage control wire will be installed with 24” tails at each field backbox and 72” tails at each control panel location.

D. At the time of commissioning the Division 16 Contractor will provide a representative who is has full working knowledge of the system, device placement and job conditions. This representative will be on-site throughout the commissioning process and will coordinate with, and aid, the Division 11 Contractor to expeditiously commission the system.

3.04 INSPECTION AND TESTING

A. Field Check-out & Final Approvals. After the system is commissioned and functions in accordance with the contract documents in the opinion of the Division 16 Contractor and the Division 11 contractor, the Consultant will inspect and test the system.

B. Make necessary arrangements for parties concerned to be present, by scheduling such inspection in a manner acceptable to the Consultant and give a minimum of 14 days notice.

C. Any defects will be repaired at once and the tests re-conducted.

3.05 RECORD DRAWINGS & OPERATION MANUAL

A. The Division 16 Contractor will provide three (3) copies of black and white prints on the system corrected in red to indicate changes made during construction.

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Comments:

A Refer to Sections 116161 and 260961 for additional information and requirements.

B Standard gang boxes are to be furnished and installed under Division 26; special boxes, as indicated on drawings, to be furnished by Division 11 Contractor and installed under Division 26.

C Standard gang boxes are to be furnished and installed under Division 26; Special boxes, including connector strips, as indicated on drawings, to be furnished under Division 11, but installed under Division 26. Refer to Sections 116161 and 260961 for additional information and requirements.

D Control cable between architectural fixtures and dimming/light control rack shall be provided under Division 26-Electrical. Termination of cable at LED driver and at light control rack shall be done under Section 116161. Division 26 Contractor to provide extra cable slack to allow for flexibility on actual final termination point at both ends.

E All DMX-Controlled Emergency Lighting Fixture Control wiring should be daisy-chained, originating at the Emergency DMX Bypass Device. Maximum QTY of (4) Emergency DMX wire runs, with maximum (32) fixtures per run.

F Division 26 to provide in addition to conduit:
- Cable tray, cable passes and J-Hooks per TCP and Electrical Drawings.
- 120 volts, 60 Hz power to individual equipment racks from dedicated power system per electrical drawings.
- 120 volts, 60 Hz dedicated receptacles fed from dedicated power system.
- Audio system isolated technical ground.
- Refer to Section 274100 for additional information and requirements.

G Refer to Sections 116170, and 260961.20, and 260961.30 for additional information and requirements.
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</thead>
<tbody>
<tr>
<td>H</td>
<td>Refer to Performance Machinery specifications and and 260961.40 for additional information and requirements.</td>
</tr>
<tr>
<td>I</td>
<td>Low voltage wiring is inclusive of any wiring, including standard stranded wire, used to carry 70 volts or less as part of the control system.</td>
</tr>
<tr>
<td>J</td>
<td>Installation refers to the installation of electrical devices, panel boards, and motor control cabinets as a part of that system.</td>
</tr>
</tbody>
</table>

END OF SCHEDULE
PART 1 - GENERAL

1.01 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.

1.02 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"

1.03 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

1.04 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

1.05 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.

1.06 REGULATORY REQUIREMENTS
A. All transformers shall be UL listed and bear the UL label.
1.07 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.

1.08 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

2.01 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.

2.02 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>Rating</th>
<th>Sound Level (dB)</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>

2.03 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.

2.04 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.

2.05 FINISH
   A. Enclosures shall be finished with ANSI 61 color, weather-resistant enamel.

PART 3 - EXECUTION

3.01 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

100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
3.02 INSTALLATION
   A. The Contractors shall install all equipment per the manufacturer’s recommendations and the contract drawings.

3.03 FIELD ADJUSTMENTS
   A. Adjust taps to deliver appropriate secondary voltage.

3.04 FIELD TESTING
   A. Measure primary and secondary voltages for proper tap settings.

END OF SECTION 26.22.00
PART 1 – GENERAL

1.01 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

1.01 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.

1.02 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

1.03 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

1.04 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

1.05 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.

1.06 REGULATORY REQUIREMENTS

A. The low-voltage switchboard shall be UL labeled.

1.07 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.

1.08 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

2.01 MANUFACTURERS

A. Eaton, Square-D, General Electric, and Siemens

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.

2.02 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.

2.03 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 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.

2.04 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.

2.05 WIRING/TERRMINATIONS

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.

2.06 ENCLOSURES

A. NEMA 1 Enclosure

2.07 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.

2.08 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.
2.09 SURGE PROTECTIVE DEVICE
   A. Provide surge protective device as specified on the drawings.

PART 3 - EXECUTION

3.01 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.

3.02 MANUFACTURER'S CERTIFICATION
   A. A certified test report of all standard production tests shall be available to the Engineer upon request.

3.03 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.

3.04 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.

3.05 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

1.01 SCOPE
A. The Contractor shall furnish and install the panelboards as specified and as shown on the contract drawings.

1.02 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

1.03 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

1.04 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

1.05 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.

A. The panelboards shall be UL labeled.
1.07 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.

1.08 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

2.01 MANUFACTURERS
A. Eaton, Square-D, General Electric, and Siemens

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.

2.02 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

2.03 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.
2.04 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.

2.05 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.

2.06 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 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.

2.07 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.

2.08 NAMEPLATES
A. Provide an engraved nameplate for each panel section.

2.09 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

3.01 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.

3.02 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

1.01 WORK INCLUDED
   A. Electrical Power 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 pad-mounted transformer secondary and continue through the main switchboard, feeder circuits, panelboards, and branch circuits to wiring devices, appliances, apparatus, and other utilization equipment.
   B. Services shall be 480Y/277 volts, three (3) phase, four (4) wire, solidly ground wye, from padmounted transformers provided by the electrical utility company. Coordinate service location and requirements with JCPB.
   C. Metering will be provided by power company at the transformer secondary bushings. Final connections at transformer secondary will be by power company.
   D. Include all utility company aid to construction costs in bid.

END OF SECTION 26.27.01
SECTION 26.27.26
WIRING DEVICES AND PLATES

PART 1 – GENERAL

1.01 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 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.
C. Special Receptacles: As indicated on Drawings, and including USB Charging type receptacles in public areas, corridors, and conference rooms.

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

1.01 WORK INCLUDED
A. Fused Disconnect Switches

1.02 SUBMITTALS
A. Provide product data showing switch’s ratings and enclosure type.

1.03 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

2.01 MANUFACTURERS
A. Switches shall be Eaton, or approved equal. Examples are Square D, General Electric, Siemens Energy & Automation.

2.02 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, dual-element, time-delay, current limiting, with blown fuse indicator site glass.

PART 3 – EXECUTION

3.01 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.
3.02 IDENTIFICATION

A. Identify disconnect switches in accordance with Section 26.05.53, "Electrical Identification."

END OF SECTION 26.28.13
PART 1 – GENERAL

1.01 SCOPE OF WORK
A. It is the intent of this specification to secure an engine-driven generator set that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.
B. Any and all substitutions shall be subject to the approval of the engineer.
C. The power system shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.
D. The equipment shall be produced by a manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year.
E. The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.

1.02 GENERAL REQUIREMENTS
A. It is the intent of this specification to secure a generator set system that has been tested during design verification, in production, and at the final job site. The generator set will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the National Electrical Code and applicable local codes and regulations.
B. All equipment shall be new and of current production by a national firm that manufactures the generator sets and controls, transfer switches, and switchgear, and assembles the generator sets as a complete and coordinated system. There will be one-source responsibility for warranty, parts, and service through a local representative with factory-trained servicemen.

1.03 SUBMITTAL
A. The submittal shall include prototype test certification and specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.

1.04 CODES AND STANDARDS
A. The generator set shall be listed to UL 2200 or submitted to an independent third party certification process to verify compliance as installed. The generator shall be EPA Certified.
B. The generator set shall conform to the requirements of the following codes and standards:
2. EN50082-2, Electromagnetic Compatibility-Generic Immunity Requirements, Part 2: Industrial.
3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
4. IEC8528 part 4, Control Systems for Generator Sets.
5. IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and conducted electromagnetic emissions.
7. NFPA 70, National Electrical Code, Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.

8. NFPA 110, Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit. Component level type tests will not substitute for this requirement.

1.05 TESTING

A. To ensure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and/or local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.

B. Design Prototype Tests. Components of the emergency system, such as the engine/generator set, transfer switch, and accessories, shall not be subjected to prototype tests because the tests are potentially damaging. Rather, similar design prototypes and preproduction models shall be subject to the following tests:

1. Maximum power (kW) and (kVA) at 0.8 lagging PF.
2. Maximum motor starting (skVA) at 35% instantaneous voltage dip.
3. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.
4. Governor speed regulation under steady-state and transient conditions.
5. Voltage regulation and generator transient response.
6. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
7. Three-phase short circuit tests.
8. Alternator cooling air flow.
9. Torsional analysis to verify that the generator set is free of harmful torsional stresses.
10. Endurance testing.

C. Final Production Tests. Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:

1. Single-step load pickup
2. Safety shutdown device testing
3. Rated Power @ 0.8 PF
4. Maximum power
5. Upon request, a witness test, or a certified test record sent prior to shipment.

D. Site Tests. The manufacturer's distribution representative shall perform an installation check, startup, and building load test. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:

1. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
2. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery chargers, alternator strip heaters, remote annunciators, etc.
3. Generator set startup under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during operation, normal and emergency line-to-line voltage and frequency, and phase rotation.
4. Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test.
5. On site minimum 4 hour load bank test with confirmed results of test in writing to A/E.
1.06 WARRANTY AND MAINTENANCE

A. The generator set shall include a five year comprehensive warranty to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from date of startup. Optional warranties shall be available upon request.

B. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and function tests performed on all systems.

PART 2 – PRODUCTS

2.01 EQUIPMENT

A. The generator set shall be a Kohler/Caterpillar/Cummins equipment with a 130 degree rise (Standby) alternator, 45kW per plans. It shall provide 56.25 kVA rating as shown on plans when operating at 277/480 volts, 60 Hz, and 0.8 lagging power factor. The generator set shall be capable of this Standby 130°C rating while operating in an ambient condition of less than or equal to 90°F and a maximum elevation of at least 3,500 feet above sea level.

B. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying a minimum of 212 skVA as indicated on plans for starting motor loads with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip i.e. engine, alternator, voltage regulator and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.

C. Vibration isolators shall be provided between the engine-alternator and heavy-duty steel base.

2.02 ENGINE

A. The minimum 4.3 liter displacement engine shall deliver a minimum of 70 HP at a governed engine speed of 1800 rpm, and shall be equipped with the following:
   1. Electronic isochronous governor capable of 0.5% steady-state frequency regulation.
   2. 12-volt positive-engagement solenoid shift-starting motor.
   3. 70-ampere automatic battery charging alternator with a solid-state voltage regulation.
   4. Positive displacement, full-pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.
   5. Dry-type replaceable air cleaner elements for normal applications.
   6. The engine shall be naturally aspirated and fueled by Natural Gas.
   7. The engine shall have at least 6 cylinders and be liquid-cooled.

B. The generator must accept rated load in one-step.

C. The engine shall be EPA certified from the factory.

2.03 ALTERNATOR

A. The alternator shall be salient-pole, brushless, 2/3-pitch, 12 lead, self-ventilated with drip-proof construction and amortisseur rotor windings and skewed for smooth voltage waveform. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The insulation shall be class H per UL1446 and the varnish shall be a fungus resistant epoxy. Temperature rise of the rotor and stator shall be limited to Standby 130°C. The PMG excitation system shall be of brushless construction controlled by a digital, 3-phase sensing, solid-state voltage regulator capable of maintaining voltage within ±2.0% at any constant load from 0% to 100% of rating. The AVR shall be capable of proper operation under severe nonlinear loads and provide individual adjustments for voltage range, stability
and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating. The waveform harmonic distortion shall not exceed 5% total RMS measured line-to-line at full rated load. The TIF factor shall not exceed 50.

B. The alternator shall have a single maintenance-free bearing, designed for 40,000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.

C. The generator shall be inherently capable of sustaining at least 300% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current-support devices.

2.04 CONTROLLER

A. Decision-Maker® 550 Controller (Kohler) or equal by Caterpillar or Cummins
   1. The generator set controller shall meet NFPA 110 Level 1 requirements (1996 version) and shall include an integral alarm horn as required by NFPA.
   2. The controller shall meet NFPA 99 and NEC requirements.
   3. The controller shall be UL 508 listed.

B. Applicability
   1. The controller shall be standard on a (to be determined).
   2. The controller shall support 12 or 24 volt starting systems.
   3. The controller's environmental specification shall be: -40°C to 70°C operating temperature range and 5-95% humidity, non-condensing.
   4. The controller shall mount on the generator or remotely within 40 feet with viewable access.

C. Hardware Requirements
   1. Control Panel shall include:
      a. The control shall have a run-off/reset-auto three-position selector switch.
      b. A controller-mounted, latch-type emergency stop pushbutton.
      c. Five indicating lights: System Ready - green; Not in Auto - yellow; Programming Mode - yellow, System Warning - yellow; and System Shutdown - red.
      d. Display with two lines of 20-alphanumeric characters, viewable in all light conditions.
      e. Sixteen position snap action sealed keypad for menu selection and data entry.
      f. For ease of use, an operating guide shall be printed on the controller faceplate.
      g. An audible alarm with alarm silence capability.
      h. Panel lights shall be supplied as standard.

D. Control Functional Requirements
   1. Field-programmable time delay for engine start. Adjustment range 0-5 minutes in 1 second increments.
   2. Field-programmable time delay engine cool-down. Adjustment range 0-10 minutes in 1 second increments.
   3. Capability to start and run at user-adjustable idle speed during warm-up for a selectable time period (0-10 minutes), until engine reaches preprogrammed temperature, or as supported by ECM-equipped engine.
   4. The idle function including engine cool down at idle speed.
   5. Real-time clock and calendar for time stamping of events.
   6. Output with adjustable timer for an ether injection starting system. Adjustment range, 0-10 seconds.
   7. Output for shedding of loads if the generator set reaches a user programmable percentage of its kW rating. Load shed shall also be enabled if the generator set output frequency falls below 59 Hz.
   8. Programmable cyclic cranking that allows up to six crank cycles and up to 35 seconds of crank time per crank cycle.
   9. The capability to reduce controller current battery draw, for applications where no continuous
battery charging is available. The controller vacuum fluorescent display should turn off automatically after the controller is inactive for 5 minutes.

10. Control logic with alternator protection for overload and short circuit matched to each individual alternator and duty cycle.

11. Control logic with RMS digital voltage regulation. A separate voltage regulator is not acceptable. The digital voltage regulator shall be applicable to single- or three-phase systems.

12. The capability to exercise the generator set by programming a running time into the controller. This feature shall also be programmable through the PC software.

13. Control function shall include output voltage adjustment.

14. Battle switch function selection to override normal fault shutdowns, except emergency stop and over-speed shutdown.

15. The control shall detect the following conditions and display on control panel:
   a. Customer programmed digital auxiliary input ON (any of the 21 inputs available)
   b. Customer programmed analog auxiliary input out of bounds (any of 7 inputs for ECM equipped engines and 5 inputs for non ECM engines)
   c. Emergency stop
   d. High coolant temperature
   e. High oil temperature
   f. Controller internal fault
   g. Locked rotor - fail to rotate
   h. Low coolant level
   i. Low oil pressure
   j. Master switch error
   k. NFPA common alarm
   l. Over-crank
   m. Over-speed with user-adjustable level, range 60-70 Hz.
   n. Over-voltage with user adjustable level, range 105% to 135%
   o. Over-frequency with user adjustable level, range 102% to 140%
   p. Under-frequency with user adjustable level, range 80% to 90%
   q. Under-voltage with user adjustable level, range 70% to 95%
   r. Coolant temperature signal loss
   s. Oil pressure gauge signal loss

16. Conditions resulting in generator warning (generator will continue to operate):
   a. Battery charger failure
   b. Customer programmed digital auxiliary input on (any of the 21 inputs available)
   c. Customer programmed analog auxiliary input on (any of the 7 inputs available on ECM equipped engines and 5 inputs for non ECM engines)
   d. Power system supplying load
   e. Ground fault detected - detection by others
   f. High battery voltage - Level shall be user adjustable
   g. Range 29-33 volts for 24-volt systems
   h. High coolant temperature
   i. Load shed
   j. Loss of AC sensing
   k. Under-frequency
   l. Low battery voltage - level shall be user adjustable, range 20-25 volts for 24-volt systems.
   m. Low coolant temperature
   n. Low fuel level or pressure
   o. Low oil pressure
   p. NFPA common alarms
   q. Over-current
E. Control Monitoring Requirements
1. All monitored functions must be viewable on the control panel display.
2. The following generator set functions shall be monitored:
   a. All output voltages - single phase, three phase, line to line, and line to neutral, 0.25% accuracy
   b. All single phase and three phase currents, 0.25% accuracy
   c. Output frequency, 0.25% accuracy
   d. Power factor by phase with leading/lagging indication
   e. Total instantaneous kilowatt loading and kilowatts per phase, 0.5% accuracy
   f. kVARS total and per phase, 0.5% accuracy
   g. kVA total and per phase, 0.5% accuracy
   h. kW hours
   i. A display of percent generator set duty level (actual kW loading divided by the kW rating)
3. Engine parameters listed below shall be monitored: (*available with ECM equipped engines)
   a. Coolant temperature both in English and metric units
   b. Oil pressure in English and metric units
   c. Battery voltage
   d. RPM
   e. Lube oil temperature*
   f. Lube oil level*
   g. Crankcase pressure*
   h. Coolant level*
   i. Coolant pressure*
   j. Fuel pressure
   k. Fuel temperature*
   l. Fuel rate
   m. Fuel used during the last run*
   n. Ambient temperature*
4. Operational records shall be stored in the control beginning at system startup.
   a. Run time hours
   b. Run time loaded hours
   c. Run time unloaded hours
   d. Number of starts
   e. Factory test date
   f. Last run data including date, duration, and whether loaded or unloaded
   g. Run time kilowatt hours
5. The following operational records shall be a resettable for maintenance purposes:
   a. Run time hours
   b. Run time loaded hours
   c. Run time unloaded hours
   d. Run time kilowatt hours
   e. Days of operation
   f. Number of starts
   g. Start date after reset
6. The controller shall store the last one hundred generator set system events with date and time of the event.
7. For maintenance and service purposes, the controller shall store and display on demand the
following information:

a. Manufacturer's model and serial number
b. Battery voltage
c. Generator set kilowatt rating
d. Rated current
e. System voltage
f. System frequency
g. Number of phases

F. Inputs and Outputs

1. Inputs
   a. There shall be 21 dry contact inputs that can be user-configured to shut down the generator set or provide a warning.
   b. There shall be 7 user-programmable analog inputs for ECM-equipped engines (5 for non-ECM engines) for monitoring and control.
   c. Each analog input can accept 0-5 volt analog signals
   d. Resolution shall be 1:10,000
   e. Each input shall include range settings for 2 warnings and 2 shutdowns
   f. All values shall be on the control panel display.
   g. Shall be user-assigned.
   h. Additional standard inputs required:
      • Input for an external ground fault detector. Digital display shall show "ground fault" upon detection of a ground fault.
      • Reset of system faults.
      • Remote two-wire start
      • Remote emergency stop
   i. Idle mode enable.

2. Outputs
   a. All NFPA 110 Level 1 outputs shall be available.
   b. Thirty outputs shall be available for interfacing to other equipment:
      • All outputs shall be user-configurable from a list of 25 functions and faults.
      • These outputs shall drive optional dry contacts.
   c. A programmable user-defined common fault output with over 40 selections shall be available.

G. Communications

1. Provide an ECM (engine control module), the controller shall communicate with the ECM for control, monitoring, diagnosis, and meet SAE J1939 standards.
2. Industry standard Mod-bus communication shall be available.
3. A Mod-bus master shall able to monitor and alter parameters, and start or stop a generator.
4. The controller shall have the capability to communicate to a personal computer (IBM or compatible) running Windows 2007 or later.
5. Communications shall be available for serial, CAN, and Ethernet bus networks.
6. A variety of connections shall be available based on requirements:
   a. A single control connection to a PC.
   b. Multiple controls on an intranet network connected to a PC.
   c. A single control connection to a PC via phone line.
   d. Multiple controls to a PC via phone line.
7. Generator and transfer switch controls shall be equipped with communications modules capable of connecting to the same communication network.
8. The capability to connect up to 128 controls (any combination of generator sets and transfer switches) on a single network shall be supported.
9. Cabling shall not be limited to the controller location.
10. Network shall be self-powered.
2.05 ACCESSORIES

A. Battery Charger. A 10-ampere automatic float to equalize battery charger with the following features:
   1. 12 or 24 VDC output
   2. Voltage regulation of 1% from no to full load over 10% AC input line voltage variations
   3. Ammeter and voltmeter with 5% full-scale accuracy
   4. LED lamp for power indication
   5. Current limited during engine cranking, short circuit, and reverse polarity conditions
   6. Temperature compensated for ambient temperatures for -40°C to 60°C
   7. UL Listed

B. Battery Rack and Cables. Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.

C. Critical Silencer. The engine exhaust silencer shall be temperature and rust resistant, and rated for critical applications. The silencer will reduce total engine exhaust noise by 25-35 db(A).

D. Circuit Breaker No. 1. The generator shall come with a factory installed, 80% rated line circuit breakers rated per plans that are UL listed, and shall provide life safety (LS) output to the “LS” ATS unit.

E. If a fire pump is present, provide factory installed load side lugs for direct connection of fire pump per NEC and NFPA requirements. Load side lug connections made at the factory shall be separated from field connections.

F. Circuit Breaker No 2. The generator shall come with a second, factory installed, 80% rated line circuit breaker rated per the plans that is UL listed, and shall provide optional standby (SB) output to the “SB” ATS. Separators shall be installed at the factory between output breakers and lugs when multiple breakers and/or lugs are required. Load side breaker connections made at the factory shall be separated from field connections.

G. Dry Contact Kits. The 10 Dry Contact Kit shall provide normally open and normally closed, gold-plated contacts in a form C configuration to activate warning devices and other customer-provided accessories allowing remote monitoring of the generator set. Typically, lamps, audible alarms, or other devices signal faults or status conditions.

H. Failure Relay.
   1. The common failure relay shall remotely signal auxiliary faults, emergency stop, high engine temperature, low oil pressure, overcrank, and overspeed via one single-pole, double-throw relay with 10 amps at 120 VAC contacts.
   2. The relay contacts shall be gold flashed to allow use of low current draw devices (100ma @ 28VDC min.).
   3. Once energized the relay shall remain latched until the system is reset by the main controller switch.

I. Flex Exhaust Tube. The exhaust piping shall be gas proof, seamless, stainless steel, flexible exhaust bellows with threaded NPT connection.

J. Rodent Guards. Generator rodent guards shall prevent intrusion and protect internal components.

K. Run Relay. The run relay shall provide a three-pole, double-throw relay with 10-amp/250 VAC contacts to indicate that the generator is running. The relay provides three sets of dry contacts for energizing or de-energizing customer devices while the generator is running (e.g. louvers, indicator lamps, etc.)

L. Standard Air Cleaner. The air cleaner shall provide engine air filtration which meets the engine manufacturer's specifications under typical operating conditions.

M. Block Heater. The block heater shall be thermostatically controlled and sized to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA 99 and NFPA 110,
Level 1.

N. Provide Natural Gas pressure regulator for engine as required at unit. Provide manufacturers data detailing Natural Gas requirements for engine as part of submittal package for coordination.

O. Remote Annunciator. Provide a NFPA 110 Compliant remote annunciator which duplicates main controller alarm and status reporting. Locate in main electrical room or as directed by owner.

2.06 SOUND ENCLOSURE

A. The enclosure shall be constructed from high strength, low alloy steel, aluminum or galvanized steel.

B. The enclosure shall be finish coated with powder baked paint for superior finish, durability and appearance. Enclosures will be finished in the manufacturer’s standard color.

C. The enclosure shall allow the generator set to operate at full load in an ambient of 40°C - 45°C with no additional de-rating of the electrical output.

D. The enclosure shall be equipped with sufficient side and end doors to allow access for operation, inspection, and service of the unit and all options. Minimum requirements are two doors per side. When the generator set controller faces the rear of the generator set, an additional rear facing door is required. Access to the controller and main line circuit breaker must meet the requirements of the National Electric Code.

E. Doors must be hinged with stainless steel hinges and hardware and be removable.

F. Doors shall be equipped with lockable latches. Locks must be keyed alike.

G. A duct between the radiator and air outlet shall be provided to prevent re-circulation of hot air.

H. The complete exhaust system shall be internal to the enclosure.

I. All acoustical insulation shall be fixed to the mounting surface with pressure sensitive adhesive or mechanically fastened. In addition, all acoustical insulation mounted on a horizontal plane shall be mechanically fastened. The acoustical insulation shall be flame retardant.

J. The enclosure shall include an exhaust scoop to direct the cooling air in a vertical direction.

K. Sound Attenuation Level shall be a maximum dB (a) level of 68 measured at 7 m or (23FT).

PART 3 – EXECUTION

3.01 TESTING

A. Provide 4 hour load bank test on site per NFPA.
PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish and install automatic transfer switch systems as indicated on drawings; 3 Pole or 4 Pole type and Ampacity as noted on drawings, 480Y277 Volt, 60Hz. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.

1.02 CODES AND STANDARDS - The automatic transfer switches and controls shall conform to the requirements of:

A. UL 1008 - Standard for Transfer Switch Equipment
B. IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment
C. NFPA 70 - National Electrical Code
D. NFPA 110 - Emergency and Standby Power Systems
E. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
F. NEMA Standard ICS10-1993 (formerly ICS2-447) - AC Automatic Transfer Switches
G. UL508 Industrial Control Equipment
H. CSA C22.2 No. 178 certification

1.03 ACCEPTABLE MANUFACTURERS

A. Automatic transfer switches shall be Kohler/Caterpillar/Cummins/ASCO or equal, OPEN – TRANSITION, 4-POLE.

1.04 SERVICE REPRESENTATION

A. The manufacturer shall maintain a national service organization of employing personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
B. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

PART 2 - PRODUCTS

2.1 MECHANICALLY HELD TRANSFER SWITCH

A. The transfer switch shall be electrically operated and mechanically held with double throw construction, and operated by a momentarily energized solenoid-driven mechanism. Main operators shall include overcurrent disconnect devices or linear motors.
B. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
C. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.

100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
D. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.

E. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

F. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources, are not acceptable.

G. The 4-pole switch shall be true open transition type, and phase conductors will break prior to neutral upon transition in both directions. All four poles will be open prior to transfer/re-transfer to destination source and neutral shall make prior to phase conductors.

2.2 ENCLOSURE
A. The ATS shall be furnished in a NEMA 1 enclosure.
B. All standard door mounted switches and long life super bright type indicating LEDs described in section 3 shall be integrated into a flush-mounted, interface membrane or equivalent in the enclosure door for easy viewing & replacement. The panel shall be capable of having manual locking feature to allow the user to lockout all membrane mounted control switches to prevent unauthorized tampering. This cover shall be mounted with hinges and have a latch that may be padlocked. The membrane panel shall be suitable for mounting by others when furnished on open type units.

2.3 CONTROLLER DISPLAY AND KEYPAD
A. A four line, 20 character LCD display and dynamic 4 button keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the communications interface port. The following parameters shall only be adjustable via a password protected programming on the controller (dip switches shall not be acceptable):
   - Nominal line voltage and frequency
   - Single or three phase sensing
   - Operating parameter protection
   - Transfer operating mode configuration (Open transition, Closed transition, or Delayed transition)

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

2.4 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING id-2-7
A. Voltage (all phases) and frequency on both the normal and emergency sources shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Dropout/Trip</th>
<th>Pickup/Reset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under voltage</td>
<td>75 to 98%</td>
<td>85 to 100%</td>
</tr>
<tr>
<td>Over voltage</td>
<td>105 to 135%</td>
<td>95 to 100% of trip</td>
</tr>
<tr>
<td>Under frequency</td>
<td>85 to 99%</td>
<td>95 to 99%</td>
</tr>
<tr>
<td>Over frequency</td>
<td>105 to 120%</td>
<td>101 to 105%</td>
</tr>
<tr>
<td>Voltage unbalance</td>
<td>5 to 20%</td>
<td>3% to 18%</td>
</tr>
</tbody>
</table>

B. Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 70°C.
C. An adjustable dropout time for transient voltage and frequency excursions shall be provided. The time delays shall be 0.1 to 9.9 seconds for voltage and .1 to 15 seconds for frequency.

D. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via the communications interface port.

E. The controller shall be capable of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or BAC). Unacceptable phase rotation shall be indicated on the LCD; the service required LED and the annunciation through communication protocol and dry contacts. In addition, the phase rotation sensing shall be capable of being defeated, if required.

F. The controller shall be capable of detecting a single phasing condition of a source, even though a voltage may be regenerated by the load. This condition shall be considered a failed source.

G. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases (phase to phase and phase to neutral), frequency, and phase rotation.

2.5 TIME DELAYS

A. An adjustable time delay of 0 to 10 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals.

B. A time delay shall be provided on transfer to the emergency source, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.

C. A time delay shall be provided on re-transfer to normal. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.

D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.

E. A time delay activated output signal shall also be provided to drive external relay(s) for selective load disconnect control. The controller shall be capable of controlling a maximum of 9 individual output time delays to step loads on after a transfer occurs. Each output may be individually programmed for their own time delay of up to 60 minutes. Each sequence shall be independently programmed for transferring from normal to emergency and transferring from emergency to normal.

The controller shall also include the following built-in time delays for the following operations:

1. 0 to 60 minute time delay on failure to acquire the acceptable electrical parameters from the emergency source.
2. 0 to 60 minute time delay for a failure to synchronize on an in-phase operation.
3. 60 minute time delay for the load disconnect position for delayed transition operation.

F. All time delays shall be adjustable in 1 second increments.

G. All time delays shall be adjustable by using the display and keypad or with a remote device connected to the communications interface port through a security-password system.

H. All time delays shall be adjustable by using the display and keypad or with a remote device connected to the communications interface port through a security-password system.

I. Each time delay shall be identified and a dynamic countdown shall be shown on the display.

2.6 ADDITIONAL FEATURES

A. The controller shall have 3 levels of security. Level 1 shall allow monitoring of settings and
parameters only. The Level 1 shall be capable of restricted with the use of a lockable cover. Level 2 shall allow test functions to be performed and Level 3 shall allow setting of all parameters.

B. Membrane-type switches shall be provided for the test functions and be maintained until the end test function is activated. The test function shall be allowed through password security. It shall be possible to defeat the password requirement by way of a circuit board mounted dip switch setting. The test function shall be load, no load or auto test. The auto test function shall request an elapsed time for test. At the completion of this time delay the test shall be automatically ended and a retransfer sequence shall commence. All loaded tests shall be immediately ended and retransfer shall occur if the emergency source fails and the normal source is acceptable.

C. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

D. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of two contacts, closed when the ATS is connected to the normal source and two contacts closed, when the ATS is connected to the emergency source.

E. LED indicating lights shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).

F. LED indicating lights shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal (green) and emergency sources (red), as determined by the voltage, frequency and phase rotation sensing trip and reset settings for each source.

G. A membrane switch shall be provided on the membrane panel to test all indicating lights and display when pressed.

H. Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.

I. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which closes to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or the communications interface port. A “not-in-auto” LED shall indicate anytime the controller is inhibiting transfer from occurring.

J. An in-phase monitor shall be a standard feature in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer. The in-phase monitor shall be capable of being enabled or disabled for the user interface. The in-phase monitor shall not be utilized as an alternative to open transition switching, shall only provide timing coordination between Normal – Open – Generator positions.

K. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to 21 different exercise routines based on a calendar mode. For each routine, the user shall be able to:
   1. Enable or disable the routine.
   2. Enable or disable transfer of the load during routine.
   3. Set the start time, time of day, day of week, week of month (1st, 2nd, 3rd, 4th, alternate or every).
   4. Set the duration of the run.
   5. At the end of the specified loaded exercise duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. All loaded exercises shall be
immediately ended and retransfer shall occur if the standby source fails. The next exercise period shall be displayed on the main screen with the type of exercise, time and date. The type of exercise and the time remaining shall be displayed when the exercise is active. It shall be possible of ending the exercise event with a single button push.

L. Date and time - The date shall automatically adjust for leap year and the time shall have the capability of automatically adjusting for daylight saving and standard times.

M. System Status - The controller shall have a default display the following on:
1. System status
2. Date, time and type of the next exercise event
3. Average voltage of the preferred and standby sources

Scrolling through the displays shall indicate the following:
1. Line to line and line to neutral voltages for both sources
2. Frequency of each source
3. Load current for each phase
4. Single or three phase operation
5. Type of transition
6. Preferred source
7. Commit or no commit modes of operation
8. Source/source mode (Utility/Gen; Gen/Gen; Utility/Utility)
9. In phase monitor enable/disable
10. Phase rotation
11. Date and time

N. Controllers that require multiple screens to determine system status or display “coded” system status messages, which must be explained by references in the operator’s manual, are not permissible.

O. Self Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

P. Communications Interface - The controller shall be capable of interfacing, through a standard communications with a network of transfer switches and generators. It shall be able to be connected via an RS-485 serial communication (up to 4000 ft. direct connect or multi-drop configuration), an Ethernet connectivity (over standard 10baseT Ethernet networks utilizing a RJ-45 port or remotely utilizing a dial-up modem). This module shall allow for seamless integration of existing or new communication transfer devices and generators. Monitoring software shall allow for the viewing, control and setup of parameters of the genset and transfer switch network through a standard personal computer utilizing current Microsoft operating systems. Separate and specific transfer switch software interfaces shall not be acceptable.

Q. The transfer switch shall also be able to interface to 3rd party applications using Modbus RTU and Modbus TCP/IP open standard protocols utilizing Modbus register maps. Proprietary protocols shall not be acceptable.

R. The controller shall contain a USB port for downloading the controller’s parameters and settings; exercise event schedules; maintenance records and event history. The file designator shall be the unique serial number of the transfer switch.

S. Data Logging - The controller shall have the ability to log data and to maintain the last 2000 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory. The controller shall be able to display up to the last 99 events. The remaining events shall be downloadable to be displayed on a computer.

1. Event Logging
   Data, date and time indication of any event.
2. Statistical Data
   - Total number of transfers.*
   - Total number of fail to transfers.*
   - Total number of transfers due to preferred source failure.*
   - Total number of minutes of operation.*
   - Total number of minutes in the standby source.*
   - Total number of minutes not in the preferred source*
   - Normal to emergency transfer time
   - Emergency to normal transfer time
   - System start date
   - Last maintenance date

* The statistical data shall be held in two registers. One register shall contain data since start up and the second register shall contain data from the last maintenance reset.

T. External DC Power Supply - An optional provision shall be available to connect up to two external 12/24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead for extended periods of time. This module shall contain reverse battery connection indication and circuit protection.

PART 3 - EXECUTION

3.1 TESTS AND CERTIFICATION

A. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

B. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, and installation and servicing in accordance with ISO 9001.

END OF SECTION 26.36.00
SECTION 26.43.13
TRANSIENT VOLTAGE SURGE SUPPRESSORS

PART 1 – GENERAL

1.01 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.

1.02 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.

1.03 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

2.01 MANUFACTURERS
A. Manufacturers: Subject to compliances with requirements, provide pre-approved product by the following:
   1. Atlantic Scientific Corporation
   2. Approved Equal.

2.02 TVSS EQUIPMENT
A. Service Entrance Suppressor:
   1. The surge protection device shall be connected to a 50A 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 150 Series (Part # 1810(4)XCA) or approved equal and must include the following ratings and accessories:
      a. 150kA 8/20 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.

PART 3 – EXECUTION

3.01 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.

3.02 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

1.01 WORK INCLUDED
A. This Section includes interior lighting fixtures, lamps, ballasts, and accessories.

1.02 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.

1.03 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.

1.04 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.

1.05 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: 10 lamps for each 100 of each type and rating installed. Furnish at least 1 of each type.
   2. Ballasts: 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

2.01 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.

2.02 LED & FLUORESCENT FIXTURES

A. Fixtures: Conform to UL 1570.
B. Ballasts: Conform to UL 935, "Fluorescent-Lamp Ballasts and LED Drivers."
   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."

2.03 LAMPS

A. Conform to ANSI Standards, C78 series applicable to each type of lamp.

2.04 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

3.01 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 and LED lamp sources shall have minimum CRI of 82.

3.02 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. 1 ½ hour burn.

E. Replace or repair malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.03 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

1.01 WORK INCLUDED
A. Fixtures
B. Controls
C. Lamps
D. Ballasts and Drivers
E. Exterior Fixtures
F. Emergency Lighting

1.02 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

2.01 ACCEPTABLE MANUFACTURERS
A. Provide fixtures as shown in the fixture schedule or approved equal.

2.02 FIXTURES
A. Provide electronic drivers in all LED fixtures and programmable rapid start ballasts in all fluorescent 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 Cree, Sylvania, Philips, Universal, Advance, or General Electric. Recessed LED and fluorescent lighting fixtures drivers and ballasts shall be provided with integral thermal protection.
B. Provide rapid start lamps for all fluorescent fixtures. Lamps shall be General Electric and 3,500 °K, CRI of 80 or better, unless specified otherwise.

2.03 CONTROLS
A. Time switches shall be Tork, Intermatic, or Paragon of types and quantity shown on Drawings.

2.04 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

3.01 GENERAL
A. Furnish, locate, and install fixtures as indicated on Drawings.
3.02 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. LED and 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 luminaries with Type THHN wire not smaller than No. 12.

F. Wire surface mounted 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
SECTION 27.01.00
REFERENCE STANDARDS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Telecommunications systems shall be provided as indicated on drawings and as called for hereinafter.

1.02 REFERENCE STANDARDS

A. ETSU Communications Infrastructure Standard (CIS) policy 500.2, October 19, 2016.
D. ANSI/NECA/BICSCI-568, Standard for Installing Commercial Building Telecommunications Cable.
E. ANSI/TIA 569-D, Telecommunications Pathways and Spaces.
F. ANSI/TIA 568.0-D, Generic Telecommunications for Customer Premises Standard Series
   568.1-D Commercial Building Cabling
   568-C.2 Copper Cabling Components
   568-C.3 Fiber Cabling Components
   568-C.4 Coax Cabling Components
G. ANSI/TIA 606-B, Addendum 1, Administration Standard for Commercial Telecommunications Infrastructure.
H. ANSI J-STD-607-B, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
I. ANSI/TIA 758-B, Customer owned Outside Plant Telecommunications Cabling Standard
J. 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.
N. International Building Code - 2006
O. IEEE 8-2.11.xx Wireless LAN’s
R. ANSI/SCTE 77 Underground Enclosure Integrity

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 27.01.00

100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
SECTION 27.05.28
TELECOMMUNICATIONS OUTSIDE PLANT (OSP)

PART 1 - GENERAL

1.01 DESCRIPTION
A. Furnish and install telecommunications outside plant (OSP) facilities as indicated on drawings and set forth hereinafter.

1.02 REFERENCE STANDARDS
A. See section 27.01.00 REFERENCE STANDARDS.

PART 2 - PRODUCTS

2.01 MATERIALS
A. Inner Duct: MaxCell 3x3 (MXD3456), locatable and metalistically detectable for OSP, with color ID.
B. Fiber Optic OSP Cable: Single Mode – Corning Altos OS2 XXXEU4-T4101D20(black); Multimode (50um) - Corning Altos OM3 XXXTU4-T4180D20 (black); Multimode (62.5um) Corning Altos OM1 XXXKU4-T4130D20 (black); XXX=strand count.
C. Copper OSP Cable: 25 Pair PE89 BSW (Buried Service Wire) Phone Cable-as manufactured by Essex or General Cable.
D. Handholes - Handhole lids shall be traffic rated (AASHTO H-20) with "Communications" logo on cover of lid.

PART 3 - EXECUTION

3.01 INSTALLATION
A. Provide one (1) 3x3 "MaxCell” innerducts in each 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”x60”x 36D” 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”x36D” 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 50 foot maintenance loop for fiber optic lines and 25 foot for copper lines in all HH. Service
loops to side of HH.

G. Label all OSP cabling as follows:
   1. "Caution Fiber Optic" adhesive marker every HH. Label to include SM and 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 27.05.28
PART 1 - GENERAL

1.01 SCOPE OF WORK
A. Furnish and install a system of cabling supports above lay-in ceilings for network, voice, and CATV cabling as set forth hereinafter.

1.02 REFERENCE STANDARDS
A. See SECTION 27.01.00 REFERENCE STANDARDS

PART 2 - PRODUCTS

2.01 MATERIALS
A. J-hooks shall be utilized above lay-in ceilings in individual rooms downstream of the cable tray for support of low-voltage cabling. J-hooks shall be as follows:
   1. Use Panduit J-Pro Series non-metallic J-hooks for all horizontal cabling from outlet to cable tray. Steel J-hooks shall not be used.
   B. Cabling support shall be located 4’ to 5’ on center throughout the entire length of network and CATV cabling runs above ceiling, once cable leaves cable tray. Provide separate sets of low-voltage cabling supports along entire length of low-voltage cabling runs above ceiling to allow separation of network cabling and CATV cabling. Network cabling shall be installed in separate J-hook support system from CATV cabling. 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. J-hook supports shall be secured directly to metal wall studs or masonry walls, as applicable. J-hooks shall not be attached directly to gyp-board walls. J-hooks shall be located no further apart than 5’0” on center along entire length of runs, with supports adjusted to be closer together as needed to attach to metal studs. A maximum of 10 Category 6 cables shall be installed per J-hook.
   C. Provide cable tray as listed in ETSU CIS throughout corridor areas of the building for support of horizontal cabling runs originating in IDF communications rooms. 18” wide x 4” deep with trapeze type hangers 8 foot on center.
   D. Provide all necessary supports and attachments to allow connection to structure for these supports.

PART 3 - EXECUTION

3.01 INSTALLATION
A. Entire installation shall be in accordance with manufacturer’s recommendations.
B. Cable tray shall be installed per manufacturer’s recommendations and shall be grounded. Cable tray shall be used for both CAT 6 and CATV cabling.
C. Provide two separate sets of low-voltage cabling supports along entire length of low-voltage cabling runs above ceiling, once leaving cable tray. 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.
D. Coordinate installation of low-voltage supports with other trades as required.

END OF SECTION 27.05.29
PART 1 – GENERAL

1.01 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

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/EIA Standards with specific labeling scheme of ETSU OIT 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 27.11.10
TELECOMMUNICATIONS SPACES

PART 1 - GENERAL

1.01 DESCRIPTION
   A. Telecommunications spaces shall be provided as indicated on drawings and as called for hereinafter. Telecommunications spaces shall consist of equipment rooms (ER).

1.02 REFERENCE STANDARDS
   A. See section 27.01.00 for standards.

PART 2 - PRODUCTS

2.01 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" Z 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 HC219CE3N (2 per patch panel) horizontal management, Hubbell MCCPSR4 cable management rings, and Hubbell 110RA cable management troughs. Provide Hubbell MCCCS19P equipment shelves.
      2. Patch Panels shall be Hubbell Category 6 patch panels. Use Hubbell HP648A with HC219CE3N, black. Provide 25% extra capacity for future growth.
      3. Cable 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 Cooper B-Line SB17U18B.
      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

3.01 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
PART 1 - GENERAL

1.01 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 Hitachi/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.

1.02 CABLEING 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)

B. HORIZONTAL CABLING
   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 REFERENCE STANDARDS

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. Each termination hardware or label shall be marked with an identifier.
   b) Each termination position label shall be recorded with an identifier.
   c) Each splice closure or label shall be marked with an identifier.
   d) "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

2.01 MATERIALS
   A. Wall-Station Jacks:
      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. Equipment Racks: See Section 27.11.10.
   D. ER Cable Tray: See Section 27.11.10.
   E. 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.

F. 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.

G. Backbone Voice Cable: Provide 50 twisted pair Cat 3 UTP riser as indicated on drawings. Backbone voice cable shall be terminated on plywood with 110, 5-pair blocks. Provide 110 troughs between backbone and horizontal 110 blocks. Use Mohawk M58522.

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); Multimode (62.5um) Corning MIC DX Armored Cable OM1 XXXK81-31130-DI (orange); XXX=strand count. All fiber shall be terminated in fiber hubs per ETUS ITS standards.

I. Firestoppping: 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.

PART 3 - EXECUTION

3.01 INTERIOR BUILDING INSTALLATION:

A. Installation of all voice and network wiring facilities shall be by personnel regularly engaged in the installation of 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. All voice cabling shall have white 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 CIS for Commissioning, Warranties, and Documentation.

E. All testing shall meet or exceed manufacturer’s recommendation for 25-year warranty program.

F. Test each pair and shield of each cable for opens, shorts, grounds, and pair reversal. Correct grounded and reversed pairs. If horizontal cable contains bad conductors or shield, remove and replace cable. Cable shall have no visible defects such as twist, kinks, and dents.

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. 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.

J. Building Automation System (BAS) Connection: Cabling connecting BAS to the ETSU ITS network must follow the standards set forth in ANSI/TIA 862.

K. Any contractor involved in the installation of these communications cabling systems shall maintain the qualifications for a BICSI registered RCDD on staff overseeing the work. Contractor shall maintain all Quality Assurance and RCDD requirements as listed in the ETSU ITS CIS.
L. Contractor shall provide all required fire-stopping of rated penetrations as required by these construction documents, applicable codes, and as required in the ETSU ITS CIS.

M. Contractor shall provide all required bonding and grounding for telecommunications systems as required by these construction documents, applicable codes, and as required in the ETSU ITS CIS.

N. Prior to commencing the installation contractor shall provide detailed submittals and shop drawings as required elsewhere in these specifications and in accordance with the ETSU ITS CIS.

END OF SECTION 27.15.00
SECTION 27.15.33
COAX HORIZONTAL CABLING

PART 1 - GENERAL

1.01 DESCRIPTION
A. Furnish and install a complete a 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”.

1.02 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.

1.03 DISTRIBUTION LEVELS
A. Line extender outputs shall be 46/40 DBMV for single cascade, and 43/37 DBMV for two cascades. No more than two line extenders shall be provided in cascade. Tap levels shall not exceed 17 DBMV on any "F" fitting. Typical tap level shall be 12 DBMV. Output level at faceplate shall be 3 DBMV and maximum of 10 DBMV. Maximum 3 DB variation shall be allowed between adjacent channels.

1.04 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

2.01 MATERIALS
A. 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.
B. Wall Plates: Wall plates for CATV outlets shall be flush mounted with single-gang Standard F81 through connector with 0 db isolation, and one 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. Amplifier: Provide one amplifier in Telecommunications Room. Each amplifier shall be two-way broadband distribution amplifier, Blonder-Tongue Model No. BIDA-750-30 or 750-50 as directed by ITS.
PART 3 - EXECUTION

3.01 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 27.41.00
PERFORMANCE AUDIO & VIDEO SYSTEMS

PART 1  GENERAL

1.01 RELATED DOCUMENTS

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

B. Electrical systems drawings and specifications under Division 26.

1.01 SUMMARY DESCRIPTION

A. This Section includes the following:

1. Audio and video systems for instruction and performance. The objective is to provide professional systems, installed, acceptance tested, and ready for use.

PART 2  PRODUCTS

2.01 EXPANDED DESCRIPTION

A. The AV Systems for the ETSU PAC include support for musical and theatrical performances of various styles with learning systems to support instruction in rehearsal spaces. See attachment for expanded system description and Statement of Probable Cost.

B. Specific products to meet the system requirements described below will be called out in the contract bid documents.

PART 3  EXECUTION

3.01 INSTALLATION

A. Furnish all materials, labor and any engineering services to provide complete and professionally installed systems in working order as described herein. Labor furnished shall be specialized and experienced in audio and video system installation.

B. Furnish and install all wire and cable.

C. Furnish all back boxes and enclosures.

D. Deliver to the job site all back boxes which are to be installed by others.

E. Furnish any additional items, not specifically mentioned herein, to meet system requirements as specified, without claim for additional payment. Such items may include hardware, transformers, line/distribution amplifiers and other devices for proper installation, interface, isolation or gain structure.

F. Furnish shop drawings and receive approval, prior to fabrication and installation.

G. Perform initial adjustments and verification tests. Submit verification test report.

H. Participate in acceptance tests and perform final adjustments.

I. Provide system documentation including copies of all relevant drawings and equipment manuals.

J. Provide maintenance services for the specified period from the date of acceptance.

K. Guarantee all equipment and components for the specified period from the date of acceptance.

L. Requirements and materials that apply to the work of others related to the audio system are listed to define and establish audio system requirements.

M. Work scope does not include the AC power system except as shown in the drawings.

END OF SECTION 27.41.00
PART 1 - GENERAL

1.01 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.

1.02 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.

1.03 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
      5. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems
      6. Other applicable NFPA standards
      7. Local Jurisdictional Adopted Codes and Standards
      8. ADA Accessibility Guidelines

1.04 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.

50% DESIGN DEVELOPMENT SPECIFICATIONS
ISSUED: 1/30/2017
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.

1.05 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.

1.06 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.

1.07 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

2.01 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 Assembly, and 4100-6075 Right Port Fiber Modem Assembly.

2.02 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.

2.03 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.

2.04 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.

2.05 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.

2.06 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.
2.07 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.

2.08 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.

2.09 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

3.01 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.
3.02 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.

3.03 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 (AHJ 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.

3.04 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.

50% DESIGN DEVELOPMENT SPECIFICATIONS
ISSUED: 1/30/2017
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.

3.05 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.

3.06 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
PART 1 GENERAL

1.01 SUMMARY
A. Work in this section includes the engineering, manufacture, furnishing, coordination and installation the interface of the fire alarm system to the Performance Equipment Systems.

1.02 SYSTEM DESCRIPTION
A. Section Includes:
1. Provide all wiring from the main fire alarm control panel to the remote equipment racks associated with the listed systems:
2. Provide relay and switching devices and all incidental material in order to provide the dry contact closures for connection to the systems circuits.
3. Connection between Fire Alarm System and Performance Equipment Systems shall comply with NFPA72 requirements of Protected Premises Fire Safety Functions.
   a. The listed fire alarm relays used to initiate control of Protected Premises Fire Safety Functions shall be located within three (3) feet the controlled circuit or appliance.
   b. Because these functions are initiated on loss of power, installation wiring between the fire alarm control unit and the relay is not required to be monitored for integrity.
   c. The wiring between the fire alarm system and the performance equipment systems shall be monitored for integrity.
B. Provision of a dry contact closure to the Performance Lighting System Emergency Devices to indicate an alarm condition.
   1. Relay operation will cause Performance Lighting System Emergency Devices to be user controllable during “normal” condition and brought to full during “Emergency” condition.
   2. Coordination:
      a. 11 6161 Contractor will provide Performance Lighting System Emergency Devices with termination points for the fire alarm system contractor to land dry contact closures.
      b. The contractors will coordinate the normal state of this closure.
C. Proscenium Fire Safety Curtain Interface Requirements
1. Alarm system actuation by Proscenium Fire Safety Curtain
   a. Coordinate with the 116137 contractor to provide an interface to notify the alarm system of an emergency closure of the Proscenium Fire Safety Curtain.
   b. Integrate a provision in the alarm system such that the Proscenium Fire Safety Curtain emergency release may be tested on a regular basis without triggering a full building alarm event.
2. Proscenium Fire Safety Curtain actuation by Fire Alarm
   a. When the provided alarm system is composed of addressable notification devices, provide such device to actuate a fire curtain release only when an alarm is triggered in the stage and/or audience zone.
   b. Unless specifically required by the Authority Having Jurisdiction, the Proscenium Fire Safety Curtain should not be actuated by an alarm initiated outside of the stage and/or audience zone.
   c. Coordinate device actuation requirements with 116137 contractor.
D. Timed smoke disarm for each performance space.
   1. Design Requirements:
      a. Provide a keyed interface that:
         1. Initiates a disarm of the smoke detectors for 3 hours when turned to the left.
         2. Cancels the timed defeat when turned to the right.
3. Indicates the system status.
4. Is labeled “Timed Smoke Detector Disarm”
5. Configure the key to be removable at all times.
   b. Provide one (1) interface per performance space.
   c. Locate interface on control booth wall in the space it controls in a location agreed upon with
      the architect.
   d. Provide an indicator on the Control Panel displaying smoke disarm condition for each
      performance space.
   e. Disarm some detectors impacted by atmospheric effects in each space. Include detectors in
      the stage, audience, return ducts, and adjacent spaces.

2. Performance Requirements:
   a. Heavy atmospheric effects should not trigger an alarm condition when the Timed Smoke
      Detector Disarm is active.

PART 2 PRODUCTS
(UNUSED)

PART 3 EXECUTION

3.01 SYSTEM TESTS AND ADJUSTMENTS
   A. Timed Smoke Detector Disarm
      1. As part of the smoke evacuation test verify that all detectors impacted by smoke are disarmed.
      2. Allow smoke to linger under performance HVAC conditions to that all detectors impacted by
         smoke are disarmed.
      3. Verify the automatic disarm.
   B. Inputs and Outputs: Verify the correct functioning of all inputs and outputs.
SECTION 31.10.00

SITE PREPARATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment and services for all site clearing, tree protection, stripping topsoil and demolition as indicated, in accord with provisions of Contract Documents.

2. Completely coordinate with work of all other trades.

3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

1.02 QUALITY ASSURANCE

A. Perform work in accord with OSHA and EPA requirements and state and local requirements.

1.03 SUBMITTALS

A. Shop Drawings: Not required.

B. Product Data: Not required.

C. Samples: Not required.

D. Project Information: Not required.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 PROTECTION

A. Provide barricades, coverings, and other protection necessary to prevent damage to existing improvements to remain:

1. Protect improvements on adjoining properties as well as those on Owner’s property.

2. Restore any improvements damaged by this work to original condition, as acceptable to Owner or other parties or authorities having jurisdiction.
B. Protect existing trees and other vegetation to remain against damage:
   1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.
   2. Avoid foot or vehicular traffic or parking of vehicles with drip line.
   3. Provide temporary protection as required. This includes temporary fencing, barricades, warning tape or other materials or means which are needed to protect the public and the contractor’s forces.

3.02 IMPROVEMENTS ON ADJOINING PROPERTY

A. Owner will obtain authority for performing removal and alteration work on adjoining property.

3.03 TOPSOIL SALVAGE

A. Definitions:
   1. Topsoil: Friable clay loam surface soil found in depth of not less than 4 IN (100 mm).
   2. Satisfactory Topsoil: Reasonably free of subsoil, objects over 2 IN (50 mm) in diameter, weeds, and roots.

B. Strip topsoil to whatever depths encountered, in manner to prevent intermingling with underlying subsoil or objectionable material.
   1. Where trees are indicated to be left standing, stop topsoil stripping sufficient distance from such trees to prevent damage to main root system.

C. Stockpile Topsoil where Directed:
   1. Construct storage piles to freely drain surface water.
   2. Seed or cover storage piles to prevent erosion.

D. Strip topsoil in all areas where changes of grade occur.

3.04 REMOVAL OF IMPROVEMENTS

A. Remove surfacing and pavements, including bases, concrete slabs, concrete curb and gutter, valve boxes, concrete walls, posts, poles, fences, manhole frames and covers, and other items indicated.

3.05 DISPOSAL OF WASTE MATERIALS

A. Do not burn combustible materials on site.

B. Remove all waste materials from site.
C. Do not bury organic matter on site.

D. Remove all rock, concrete, asphalt, and masonry from site.

3.06 DISPOSAL OF EXCESS TOPSOIL

A. Excess topsoil, not required for re-use on lawns, landscaped and seeded areas may be removed from the site.

3.07 REMOVAL OF DEBRIS

A. Remove all debris from the site and dispose of all removed material legally off site. Leave the site in a neat and orderly condition to the approval of the Designer. Debris receipts will be required to be turned over to the Owner.

3.08 SAFETY

A. The Contractor is to observe all Safety Laws of Local, State and Federal Government in executing this work. This specifically includes all O.S.H.A. Requirements.

B. Provide all warning signs, barricades, lights and other necessary safety devices required by Agencies mentioned in Paragraph 3.08.A.

C. Protect the occupants of the facility, the general public, and workers at all times.

3.09 CLEAN-UP

A. The Contractor is to keep his operations clean at all times during execution of demolition work.

B. Streets, highways, roads, existing paved areas and sidewalks shall be cleaned of all mud, dirt, and debris daily and kept clean during construction of this project.

END OF SECTION 31.10.00
SECTION 31.20.00

EARTHWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rough grading and finish grading, including compaction of fill, shall be performed as a part of this contract.

B. This contract shall include trenching for utilities and footings, backfilling and compaction of trenches, and providing subbase under slabs and paving.

C. Backfill and Fill: Use soil material free of clay, rock, or gravel larger than 2: in any direction, debris, vegetable matter, waste, and frozen materials, with plasticity index less than 30.

D. Slab On Grade Subbase: Use washed, uniformly graded mixture of crushed stone, or crushed or un-crushed gravel, with 100% passing a 1-1/2" sieve and not more than 5% passing a No. 4 sieve.

E. Pavement Subbase: Use naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, natural or crushed sand, as acceptable to Designer.

F. Compaction: Provide not less than the maximum density (standard proctor) for soils compacted at optimum moisture content, for the actual density of each layer of soil material in place listed in the Soils Report recommendations in this manual.

G. Rock Excavation:

1. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following:

   a. 24 inches (600 mm) outside of concrete forms other than at footings.

   b. 12 inches (300 mm) outside of concrete forms at footings.

   c. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.

   d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.

   e. 6 inches (150 mm) beneath bottom of concrete slabs on grade. 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.
H. Excavation and Dewatering: It is anticipated that ground water will be encountered in the areas of deeper undercut (beyond 5’ below finished floor) and that dewatering will be required.

I. Classification and Excavation: Rock is defined as solid non-soil masses other than demolition items that cannot be removed with a track mounted excavator.

END OF SECTION 31.20.00
SECTION 31.22.00
EXCAVATION, BACKFILLING AND COMPACTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Excavation for building foundations.
B. Excavation for slabs-on grade, paving and landscaping.
C. Excavation for site structures.
D. Excavation for Mechanical/Electrical Work: Excavation and backfill required in conjunction with underground mechanical and electrical utilities, and buried mechanical and electrical appurtenances.
E. Backfilling of trenches.
F. Building perimeter and site structure backfilling to subgrade elevations.
G. Fill under paving.
H. Fill over-excavation.
I. Consolidation and compaction.
J. Filling where required to obtain finish grade or subgrade.

1.02 REFERENCE STANDARDS


1.03 QUALITY ASSURANCE

A. Codes and Standards: Perform excavation work in compliance with contract documents and applicable requirements of governing authorities having jurisdiction.
B. An Allowance for testing service for quality control testing and on-site job observation during earthwork operations is included in the Contract. Refer to Section 01.20.00 ALLOWANCES of the specifications.

1.04 JOB CONDITIONS

A. A Subsurface Investigation Report, dated 10-08-2015, has been prepared by Foundations Systems Engineering, P.C. and may be referenced to in Section 02.23.00 - SUBSURFACE CONDITIONS.
B. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that the Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data is made available for convenience of Contractor.

C. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.

D. Verify that survey benchmark and intended elevations for the Work are as indicated.

E. Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.

F. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

G. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, during occupied hours, except when permitted in writing by Designer and then only after acceptable temporary utility services have been provided.

1. Provide minimum of 48-hour notice to Designer and receive written notice to proceed before interrupting any utility.

1.05 USE OF EXPLOSIVES

A. Explosives may not be used.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. Fill soils shall have standard proctor (ASTM D-698) dry unit weight of greater than 90 pcf and a Plasticity Index (PI) of less than 30%. Geotechnical Engineer shall approve all fill material used on site.

B. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100% passing a 1" sieve and not more than 5% passing a No. 4 sieve.

C. Backfill and Fill Materials: Satisfactory soil materials of clay, rock or gravel not larger than 2" in any dimension, free of debris, waste, frozen materials, vegetable and other deleterious matter. Plasticity index of less than 36%.

2.02 COMMON FILL MATERIALS

A. Subsoil: Reused; or imported; excavated material free of gravel larger than 3 inch size, and debris. Plasticity index of 30% or less.
2.03 FILTER FABRIC

A. 'TYPAR' 3601 or as approved equal.

B. Biaxial Geogrid Reinforcement – Type 2, Terragrid BX 1200 or Approved Equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify with Designer/Soils Engineer that fill materials to be reused are acceptable.

B. Verify with Designer that foundation perimeter drainage installation (if any) has been inspected.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Generally, compact subgrade to density requirements for subsequent backfill materials.

C. A heavily loaded, single axle dump truck utilizing a crisscross pattern should be utilized in areas that will receive structural fill to determine if any soft areas exist or sever pumping of the in place soils occur.

D. Prior to placement of aggregate base course material at building slabs or paved areas, compact subsoil to no less than 98% percent of the standard proctor maximum dry density in accordance with ANSI/ASTM D698. All fill beneath pavements and grade slabs shall be compacted to 98% percent. Moisture content of fill soils shall be maintained within +2 and -2 percentage points of the optimum moisture content determined from the standard proctor compaction test.

E. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.

F. Protect above and below grade utilities which are to remain.

3.03 EXCAVATION

A. Excavation is classified.

B. The bidder shall draw his own conclusions as to the conditions to be encountered.

C. Do not allow water to accumulate in excavations. Remove water to prevent softening of subgrade foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.
D. Excavation for Trenches: Dig trenches to the uniform width required for particular item to be installed, sufficiently wide to provide ample working room. Provide 6" to 9" clearance on both sides of pipe or conduit.

E. Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Beyond building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze-ups.

Where rock is encountered, excavation shall be required to carry 1'-0" below required elevation and backfill with a 6" layer of crushed stone or gravel prior to installation of pipe.

F. Temporary construction excavations should be sloped or shored in accordance with Local, State and Federal Regulations including OSHA (29 CFR Part 1926) excavation and trench safety.

3.04 BACKFILL AND FILL

A. General: Place acceptable soil material in layers to required subgrade elevations, for each area.

B. Building Slab Drainage Course:

1. General: Drainage course consist of placement of a minimum of 4" of stone; Comprised of 4" of compacted crushed run stone. Crusher run stone is to be placed directly under slab.

2. Placing: Place drainage fill material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting material during placement operations.

3. When a compacted drainage course is shown to be 6" thick or less, place material in a single layer. When shown to be more than 6" thick, place material in equal layers, except no single layer more than 6" or less than 2" in thickness when compacted.

3.05 COMPACTION

A. General: Control soil compaction during construction providing minimum percentage of density specified for each area classification indicated below.

B. All compacted fill shall be constructed by spreading acceptable soil in loose layers not more than 8 inches thick. The soils used within proposed building and paved areas shall be compacted in lifts to at least 98 percent of the standard Proctor maximum dry density (ASTM D-698). At grade slabs, limit of compaction will extend 10'-0" beyond edge of slab.

The moisture content of the fill soils shall be maintained within +2 and -2 percentage points of the optimum moisture content determined from the standard Proctor compaction test.

1. Lawn or Unpaved Areas: Compact top 6" of subgrade and each layer of backfill or fill material to at least 90% maximum density.
2. Walkways: Compact top 12" of subgrade and each layer of backfill or fill material to at least 98% maximum density.

3. Embankment Areas Around Buildings and Retaining Walls - 98%.

4. Paved Areas – 98% (in upper 2 feet from subgrade).

5. Paved Areas – 95% (below 2 feet from subgrade).

6. Trench Lines – per the above depending upon location/elevation.

C. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations.

D. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

E. Soil material that is to be removed under the building may be used if it meets the requirements of the specification for use under parking lots. It is anticipated that some soils required to be removed will not be suitable for re-use and will have to be discarded off site.

3.06 TOLERANCES

A. Top Surface of Backfilling: Under Paved Areas: Plus or minus one inch from required elevations.

B. Top Surface of General Backfilling: Plus or minus one inch from required elevations.

3.07 FIELD QUALITY CONTROL

A. Contractor will engage testing service for quality control testing and on site job observation during earthwork operations. Testing service is to be approved by the Designer prior to start of construction.

B. Tests and analysis of fill material will be performed in accordance with ANSI/ASTM D698.

C. Compaction testing will be performed in accordance with ANSI/ASTM D698.

D. If tests indicate Work does not meet specified requirements, work will be required to be removed and reworked until work meets test requirements and the requirements of the contract documents.

E. Quality Control Testing During Construction: Allow testing service to inspect and approve subgrades and fill layers before further construction work is performed.

F. Footing SubGrade: For each strata of soil on which footings will be placed, allow tests to verify required design bearing capacity of 2000 lbs/s.f.

G. Paved Areas and Building Slab SubGrade: Allow tests to verify required design bearing capacities.
H. Foundation Wall Backfill: Allow for field density tests to verify design requirements.

3.08 PROTECTION

A. Protect excavations by methods required to prevent cave in or loose soil from falling into excavation.

B. Protect bottom of excavations and soil adjacent to and beneath foundation, from freezing.

C. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Provide temporary drainage swales or other structures to prevent ponding of water within construction limits.

D. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

E. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

F. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other construction), add backfill material, compact, and replace disturbed construction. Restore appearance, quality, and condition of surface, finish and construction to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.09 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Removal from Owner’s Property:

1. Remove trash, debris, roots, tree stumps, mass rock, and dispose of it off Owner’s property. Contractor is responsible for material that leaves the site.

2. Remove excess soils from site. Contractor will be responsible for leveling dumped material and to make an effort to minimize run off of dumped materials. Contractor is responsible for material that leaves the site and its proper disposal.

END OF SECTION 31.22.00
SECTION 31.22.10

GRADING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Spread existing topsoil as required by these Specifications for proper growth of seeding, ground cover, and landscaping.

B. Excavate topsoil at areas where new walks, buildings or other miscellaneous construction is to be installed.

C. Finish grade where required.

D. Place, level, and compact topsoil.

1.02 QUALITY ASSURANCE

A. Codes and Standards: Perform grading in compliance with requirements of governing authorities having jurisdiction.

1.03 SAMPLES

A. Submit samples under provisions of Section 01.30.00.

B. Submit 10 lb. sample of imported fill to testing laboratory, in air-tight containers.

1.04 PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Section 01.30.00.

B. Accurately record location of utilities remaining, rerouted utilities, new utilities by horizontal dimensions, elevations or inverts, and slope gradients.

1.05 PROTECTION

A. Protect trees, shrubs, lawn, and other features remaining as portion of final landscaping.

B. Protect bench marks, existing structures, fences, roads, sidewalks and paving and curbs.

C. Protect above or below grade utilities which are to remain.

D. Repair damage to items indicated to remain. Restore to condition before construction.
PART 2 - PRODUCTS

2.01 MATERIALS

A. Topsoil: Excavated material, graded free of roots, rocks larger than one inch subsoil, debris, and large weeds. If additional topsoil is required to complete work, Contractor shall furnish them offsite.

B. Subsoil: Excavated material, graded free of lumps larger than 6 inches; rocks larger than 3 inches and debris.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify site conditions and note irregularities affecting work of this Section before beginning work.

B. Beginning work of this Section means acceptance of existing conditions.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Identify known below grade utilities. Stake and flag locations.

C. Identify and flag above grade utilities.

D. Maintain and protect existing utilities remaining which pass through work area.

E. Notify utility company to remove and relocate utilities.

F. Upon discovery of unknown utility or concealed conditions.
   1. If active and damaged, immediately restore to working order, discontinue affected work, notify Designer.
   2. Otherwise, discontinue affected work, notify Designer.

3.03 TOPSOIL

A. Excavate topsoil from areas to be further excavated, re-landscaped, or re-graded and stockpile on site.

B. Excavate topsoil (1-1/2' depth) from new construction areas, parking areas, any area that will require structural fill or any area which will have concrete pads or structures placed in that area. There will not be any topsoil excavation required in the building area. See drawings for further description.

C. Do not excavate wet topsoil.

D. Cover or protect topsoil from erosion.
3.04 PLACING TOPSOIL

A. Place topsoil in areas where planting is scheduled and where indicated on drawings. The majority of the site has topsoil in place.

B. Use topsoil in relatively dry state. Place during dry weather.

C. Fine grade topsoil eliminating rough or low areas. Maintain levels, profiles, and contours of subgrade.

D. Remove stone, roots, grass, weeds, debris, and foreign material while spreading.

E. Manually spread topsoil around trees, plants and building to prevent damage.

F. Lightly compact placed topsoil.

G. Remove surplus subsoil and topsoil from site. Refer to Paragraph 3.09, Section 31.22.00, Excavation, Backfilling and Compaction.

H. Leave stockpile area and site clean and raked, ready to receive landscaping.

I. Schedule of Locations:

1. The following paragraphs identify compacted topsoil thicknesses for various locations.
2. Seeded Grass: 6" inches.
4. Shrub Beds: 18" inches.
5. Flower Beds: 12" inches.

3.05 TOLERANCES

A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding.

C. Finish surfaces free from irregular surface changes, and as follows:

1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10' above or below required subgrade elevations.
2. Walks: Shape surface of areas under walks to line, grade and cross section, with finish surface not more than 0.10' above or below required subgrade elevation.
3. Pavements: Shape surface of areas under pavement to line, grade and cross section, with finish surface not more than 1/2" above or below required subgrade elevation.

END OF SECTION 31.22.10

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PART 1 - GENERAL

1.01 SECTION INCLUDES
A. Soil treatment for termite control, as herein specified.

1.02 QUALITY ASSURANCE
A. In addition to requirements of these specifications, comply with manufacturer’s instructions and recommendations for work, including preparation of substrate and application.
B. Engage a professional pest control operator, licensed in accordance with regulations of governing authorities for application of soil treatment solution.

1.03 JOB CONDITIONS
A. Restrictions: Do not apply soil treatment solution until excavating, filing and grading operations are completed, except as otherwise required in construction operations.
B. To insure penetration, do not apply soil treatment to frozen or excessively wet soils or during inclement weather. Comply with handling and application instructions of the soil toxicant manufacturer.

1.04 SUBMITTALS
A. Product Data: Submit manufacturer’s technical data and application instructions.
B. Furnish written warranty certifying that applied soil poisoning treatment will prevent infestation of subterranean termites and, that if subterranean termite activity is discovered during warranty period, Contractor will retreat soil and repair or replace damage caused by termite infestation.
   1. Provide warranty for a period of 5 years from date of treatment, signed by Applicator and Contractor.

PART 2 - PRODUCTS

2.01 SOIL TREATMENT SOLUTION
A. Provide a working solution of the following chemical element and concentration;
   1. Termidor SC - Minimum Concentration .06%, 1 Gallon finished dilution/square foot around anything penetrating the slab (i.e. Utility Services, Plumbing Lines, etc.) and at 4 Gallons of dilution per 10 linear feet per foot of depth along the inside and outside perimeter of foundation walls. Treatment along inside of foundation walls at the rate of 4 Gallons finished dilution (.06%, .09%, or .125% Termidor SC) per 10 linear feet per foot of depth, or if the footing is more than 4 feet below grade.
B. Use only solutions acceptable to governing authorities. Use only soil treatment solutions which are not injurious to planting.

PART 3 - EXECUTION

3.01 PREPARATION

A. Remove foreign matter which could decrease effectiveness of treatment on areas to be treated. Loosen, rake and level soil to be treated, except previously compacted areas under slabs and foundations. Toxicants may be applied before placement of compacted fill under slabs, if recommended by toxicant manufacturer.

3.02 APPLICATION

A. Apply strictly by manufacturer’s recommendations complying with all safety recommendations, environmental precautions and discretions.

END OF SECTION 31.22.81
SECTION 31.25.00

EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.01 DESCRIPTION

A. This section includes the provisions of the Storm Water Pollution Prevention Plan (SWPPP) in accordance with the Tennessee General NPDES Permit (TNR100000) for storm water discharges associated with construction activity (TCNP) as required by the State of Tennessee. Contractor is responsible for carrying out all construction activity in compliance with the SWPPP.

B. The construction activity will be carried out in such a manner as will prevent any discharge that would cause a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of the waters on the property or downstream of the property for fish and aquatic life, livestock watering and wildlife, recreation, irrigation, navigation, or industrial or domestic water supply.

C. A complete copy of the SWPPP and the NPDES Permit are 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 complete copy will be provided to any Bidder of Record upon request.

1.02 REQUIREMENTS

A. Provide under this section all measures required by the enclosed Storm Water Pollution Prevention Plan (SWPPP) the Federal Clean Water Act of 1972 with 1977 Amendments and associated Tennessee State Regulations, including but not limited to:

1. All required Certifications.
2. Posting of Certifications and Permits.
3. All required inspections and records.
4. Submission of inspections and records.

1.03 CONTRACTOR RESPONSIBILITIES FOR PERMIT IMPLEMENTATION

A. The Contractor shall identify the following to the Owner, Designer and TDEC prior to commencement of soils disturbing activities.
1. Individual responsible for installation, maintenance and inspections of erosion and sediment control measures. Contractor's assigned person shall have completed the Fundamentals of Erosion Prevention and Sediment Control course offered by the State of Tennessee.

2. Contact information for that individual, including cell phone number.

B. Any new Contractors or Subcontractors on the project that have any responsibility to install, inspect, or maintain erosion or sediment control measures will sign the Contractor's Certification on a copy of the NOI (Appendix A of the SWPPP) and will submit it to the local EAC. Any correspondence with TDEC or any EAC will reference the tracking number assigned by TDEC to the project. McCarty Holsaple McCarty, Inc., will submit a Notice of Termination (NOT; Appendix B of the SWPPP) after the complete installation and successful establishment of the final stabilization activities at the site.

1. All Contractors involved in soil disturbing activities are required to sign a Notice of Intent (NOI) and submit the same to the Architect and TDEC prior to commencement of activities. Primary Contractor shall additionally sign the SWPPP.

2. Contractor shall be required to reimburse the Owner for any fines levied due to non-conformance or non-compliance with these requirements.

END OF SECTION 31.25.00
SECTION 31.63.33

MICROPILES

PART 1 - GENERAL

1.01 SCOPE

A. This work shall consist of Micropiles, designed, furnished, installed and tested in accordance with these specifications and as shown on the contract drawings.

1.02 LOAD CARRYING CAPACITY

A. Unless otherwise directed, the contractor shall select the Micropile type and the installation method, and determine the length and diameter. The contractor shall be responsible for installing in accordance with the testing subsection of this specification. Contractor's proposal for said work shall explain in detail the materials, methods, and design assumptions that will employed.

B. Applicable Standards:


   a. A370 - Test Methods and Definitions for Mechanical Testing of Steel Products.
   b. A536 - Ductile Iron Castings.
   c. A563 - Carbon and Alloy Steel Nuts.
   d. A672 - High-Strength Low-Alloy Columbium - Vanadium Structural Steel.
   e. A722 - Uncoated High-Strength Steel Bar for Prestressing Concrete.
   f. A775 - Epoxy-Coated Steel Reinforcing Bars
   g. C33 - Concrete Aggregates.
   i. C150 - Portland Cement.
   l. F436 - Hardened Steel Washers.
   m. D1143 Testing of Pile's under Axial Compression Load.
   n. FHNA NHI – 05-039.

1.03 QUALIFICATION

A. The contractor performing the work described in the specification shall have installed Micropiles for a minimum of ten years. At the time of bid, the contractor shall submit a list containing at least five projects on which the contractor has installed Micropiles. A brief description of each project and a reference shall be included for each project listed. As a minimum, the reference shall include an individual's name and current phone number.

B. Prior to the start of work, the contractor shall submit a list identifying the Micropile Engineer, drill operators and on-site supervisors who will be assigned to the project. The list shall contain a summary of each individual's experience and it shall be complete enough for the Project Structural Engineer of Record to determine whether or not each individual has satisfied the following qualification.

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C. The contractor shall assign a Micropile Engineer to supervise the work with at least five years of experience in the design and construction of Micropiles. The use of manufacturer's representatives does not satisfy the requirements of this section. Drill operators and on-site supervisors shall have a minimum of five year experience installing Micropiles with the contractor's organization.

D. The Project Structural Engineer of Record shall approve or reject the contractor's qualifications and staff within 15 working days after receipt of the submission. Work shall not be started on any piling nor any materials ordered until approval of the contractor's qualifications is given. The Engineer of Record may suspend the Micropile work if the contractor substitutes unqualified personnel for approved personnel; the contractor shall be fully liable for additional costs resulting from the suspension of work and no adjustment in contract time resulting from the suspension of work will be allowed.

E. The contractor shall submit a detailed narrative within his proposal describing the construction method he intends to employ and encompassing all aspects, peripheral or otherwise, of his site operation.

F. Please note the owner (and his contracts manager as appropriated) reserves the right to reject any or all bids on the basis of price or in the belief that the narrative content does not reveal that the contractor has given due thought to the construction process.

1.04 SUBMITTALS

A. The contractor shall prepare and submit to the Engineer of Record for review and approval, working drawings and design submission describing the Micropile system or systems intended for use. The working drawings and design submission shall be submitted 30 calendar days prior to the commencement of the Micropile work. The working drawing and design submission shall include the following:

1. Design Build Micropile system.

   a. Detailed Shop Drawings for each micropile type showing all dimensions and components, including capacity, all micropile components, associated hardware and connection details. Complete details of the micropile fabrication, drilling and grouting methods, testing procedure, and installation procedure for each micropile type.

   b. Design calculations in accordance with FHWA or AASHTO guidelines for allowable stresses in steel and grout under design loading conditions. If lateral loading is expected, the design calculations shall include computer simulation using LPILE or GROUP. The design output representing the performance of the group under the design load conditions shall be considered part of the required design calculations.

   c. Sequence of construction.

   d. Proposed stressing and load test equipment and procedures, including calibration curves for pumps, jack, and gauges.

2. Miscellaneous Submittals:

   a. Mill test reports for all material, indicating ultimate strength, modulus of elasticity and percent of elongation at rupture of steel.
b. Grout cube test reports, including compressive strength at 28 days.

3. A drawing showing the location and orientation of each Micropile. A Micropile schedule giving:
   - Micropile number;
   - Micropile design load; and
   - Type and size of Micropile.

Details of all Connections.

B. The Engineer of Record shall approve or reject the contractor's working drawings and design submission within 20 working days after receipt of the submission.

C. The contractor shall submit to the Engineer of Records for review and approval or rejection mill test reports for the steel piling components.

D. The contractor shall submit to the Engineer of Record for review and approval or rejection calibration data for each test jack, pressure gauge and master pressure gauge to be used. The calibration tests shall have been performed by an independent testing laboratory and test shall have been performed within 60 calendar days of the date submitted. The Engineer of Record shall approve or reject the calibration data within five working days after receipt of the data. Testing cannot commence until the Engineer of Record has approved the jack, pressure gauge and master pressure gauge calibration.

E. The contractor shall submit to the engineer within 30 calendar days after completion of the Micropile work a report containing:
   - As-built drawings showing the locations of the Micropiles and the piles length.
   - Steel manufacturer's mill test reports for the steel pile components incorporated in the installation.
   - Detailed drilling records including depth to rock quality.
   - Grouting records indicating the cement type, and quantity injected.
   - Micropile test results and graphs.

F. Construction Records: Provide Load Test results to include the following for each test:

   1. Micropile number.
   2. Micropile location.
   4. Total length, micropile bond length, and unbonded length.
   5. Date of installation.
   6. Description of rock materials penetrated during drilling.
   7. Observation of voids, seams, or water flows during drilling.
   8. A data sheet of all loading increments with deflection and times recorded.
   9. Load-deflection plots for load testing.
   10. Loading sequence and total deflection at each load.
   11. Time vs. load plot
   12. All pertinent information required to evaluate the performance of the micropile tests.
PART 2 - PRODUCTS

2.01 MATERIAL

A. Micropile casing: 80ksi minimum yield strength

B. Reinforcing steel: Deformed bars, 75ksi maximum yield strength to maintain strain compatibility with grout in compression if grout is used to carry any portion of the compressive load.

C. Connection Nuts and Washers:
   1. All components and hardware shall be compatible with the specified micropile bars and shall be capable of developing 95% of the ultimate tensile strength of the prestressing steel.
   2. Nuts, bearing plates and other connection components shall be as shown on micropile design shop drawings.

D. Micropile Grout shall consist of a neat cement mixture so proportioned to exhibit a water cement ratio between 0.35 and 0.45, to produce a hardened mortar compressive strength of 4,000 psi at time of performance load tests and proof load tests within dates as respectively noted in PART 3, ARTICLE 3.01.

   a. Portland Cement: Type I or II, conforming to ASTM C150.
   b. Water: Only potable water is acceptable.
   c. Fine Aggregate, when used:
      (1) Fine aggregate shall meet the requirements of ASTM C33.
      (2) Fine aggregate shall consist of clean sand or of hard, dense, durable, uncoated rock particles and shall be free from injurious amounts of silt, loam, lumps, soft or flaky particles, shale, alkali, organic matter, mica, and other deleterious substances.
      (3) Fine aggregate shall not have detrimental effects on grout pumpability or homogeneity.
   d. Agents and Admixtures: Use of admixtures to add thixotropic properties to the grout such as diutan gum or welan gum are permitted and should be used as needed to reduce grout loss into fractured rock.

E. Perform grout cube compression tests as follows:

   a. Furnish 2" x 2" x 2" molds and mortar cubes, 2"x4", or 3"x6" cylinders for strength testing.
   b. Furnish and transport to an approved laboratory 6 test samples for each 1.5 cubic yards of grout placed, with a minimum of 6 samples for each foundation or for each day's placement, whichever is greater.
   c. Two samples shall be tested in compression at 3 or 7 days, two at 28 days, and two shall be held.

F. Corrosion Protection:

   1. Micropile corrosion protection shall be "simple corrosion protection" as follows:
a. If reinforcing steel is used to carry the load in "uncased" rock sockets, the bonded length shall be clean, epoxy coated steel and shall have a cover of at least 1.0-inch of portland cement grout.

b. Casing shall provide 1/16" sacrificial steel on its exterior. Load calculations shall not include sacrificial steel for the purpose of carrying load of any type.

G. Centralizers: Shall be fabricated from material which is nondetrimental to the micropile steel. Wood shall not be used. The centralizer shall position the micropile in the drill hole so a minimum of 1.0-inch of grout cover is provided and shall be spaced at intervals not exceeding 10 feet.

2.02 EQUIPMENT

A. Grouting Equipment:

1. Capable of continuous mechanical mixing that will produce a uniform and thoroughly mixed grout free of lumps and undispersed cement at required pressures.

2. Colloidal (high speed, high shear) mixers shall be used.

3. Mixers, storage tanks and pumps shall have adequate size and capacity to allow continuous grouting of an individual bar within a period of less than 1/2 hour.

4. The accuracy of batching equipment shall be sufficient to control the water-cement ratio of the grout to within +5% of the target value.

5. Capable of grouting at a pressure of at least 150 psi, sufficient to overcome any hydrostatic pressure that may exist with enough excess pressure to ensure complete and adequate grouting, and prevent introduction of oil, air, or other foreign substances into the grout. No loss of water from the grout due to poor seals, poor connections, or other causes will be permitted.

6. Positive displacement grout pump shall be used.

7. Screen to limit grout particles with 1/8-inch mesh openings.

8. Pressure gauge to monitor grout pressures shall be attached to grout line just prior to entering hole.

B. Testing Equipment: Capable of applying a load of at least 200% of the proposed design load, and shall include appropriate gauges to indicate the load applied with an accuracy within 2% of the target load and to measure associated displacements. Dial gauges shall have a precision of 0.001 inch with at least 2 inches of travel as a minimum, and more if necessary to insure that no adjustment of dial gauges is required during the performance of the load test.

C. Hydraulic Jacks: Capable of reaching desired test load of all stressed elements of the micropile.
PART 3 - EXECUTION

3.01 INSTALLATION

A. Drilling

1. Unless otherwise directed, core drilling, rotary drilling, percussion drilling, auger drilling, driven casing or other acceptable means can be used. The Micropile can be installed in the drill hole after drilling or it can be advanced by the drill.

B. Grouting

1. The contractor shall use a neat cement grout or a sand-cement grout with a minimum 28 day unconfined compressive strength of 4,000 psi. The cement shall not contain lumps or other indications of hydration. Admixtures, if used, shall be mixed in accordance with the manufacturer’s recommendation.

2. The grouting equipment shall produce a grout free of lumps and undispersed cement. The pump shall be equipped with a pressure gauge to monitor grout pressures. The pressure gauge shall be capable of measuring pressure of at least 150 psi or twice the actual grout pressures used by the contractor, whichever is greater. The grouting equipment shall be sized to enable the grout to be pumped in one continuous operation. The mixer should be capable of continuously agitating the grout.

3. The grout shall be injected from the lowest point of the drill hole. The grout may be pumped through grout tubes, casing, hollow-stem-augers or drill rods. The quantity of grout and the grout pressures shall be recorded. The grout pressures and grout takes shall be controlled to prevent excessive heave in cohesive soils or fracturing of rock formations. The entire Micropile shall be filled with grout.

4. Upon completion of grouting, the grout tube may remain in the hole but it shall be filled with grout.

5. After grouting, the Micropile shall not be loaded for a minimum of three days.

6. Finishing:
   a. Upon completion of micropile drilling and grouting, top connections shall be installed at the proper elevation per designer’s direction.

7. Installation Tolerances:
   a. Minimum hole size shall be as indicated on the Drawings for each micropile type.
   b. Horizontal and vertical tolerances for completed piles shall be 3 inches from design location and cut off elevation.
   c. Holes shall be drilled within 2 degrees of the desired angle of inclination relative to the drilled depth.
8. Rejected Micropiles:
   a. Resident Project Representative will determine acceptability of all
      micropiles placed and may reject those which do not conform to the
      specifications.
   b. All micropiles not installed in accordance with the tolerances as specified
      will be rejected unless accepted by project Structural Engineer of Record
      and Micropile Designer.
   c. Micropiles which have been rejected shall be left-in-place, cut off 6
      inches below concrete elevation and a new micropile shall be installed at
      a location designated by Structural Engineer of Record to replace the
      rejected micropile.

3.02 TESTING

A. Instruction:

1. A minimum of one test pile shall be loaded to twice the design load. The load test shall be
   evaluated by the contractor and engineer to evaluate compliance with job performance
   requirements.

2. Unless otherwise stated, a Performance test shall be conducted on 2% of the micropiles
   or a maximum of 4 micropiles, whichever is greater to allow evaluation of load deflection
   behavior. At least one micropile shall be tested near the center of the work area if
   possible. The testing shall be distributed across the site to present representative
   conditions for all production micropiles. At no time shall the test exceed 80% of the
   ultimate tensile strength of any steel or threaded connections placed in tension during
   testing, including reaction anchors.

3. The load shall be applied with a calibrated hydraulic jack. A leveling plate shall be attached
   to the surface of the test pile and the jack shall be set in position with the load centered on
   the pile.

4. The tests shall be performed in accordance with ASTM D 1143-81, Testing of Piles under
   Axial Compressive Load.

5. The test load shall be applied in compliance with ASTM D 1143-81, Paragraph 5.6 Quick Pile
   Test. In essence the load shall be applied in intervals in increments of 20 percent of the
   anticipated working load to maximum of a least 200 percent of the working load. The
   maximum load shall be maintained for 1 hour or until the settlement is less than or equal to
   0.001 foot per hour. Load increments shall be maintained as applied as described in ASTM D
   1143.81, Paragraph 5.4. Load increments shall be maintained as applied as described in
   ASTM D1143-81, Paragraph 5.4. Readings of settlements and rebounds shall be referred to a
   constant elevation benchmark and shall be recorded to 1/1000 of a foot for each increment
   or decrement of load.

6. Following the 1-hour hold on the maximum load, the test piles shall be rebound as described
   in ASTM D 1143.81, Paragraph 6.2. Six settlement and rebounded readings shall be made in
   addition to the initial and final readings (total of 8) during each load or rebound cycle.
7. The rebound curve shall be established by unloading in decrements of 75, 50, 25 and 10 percent of the total applied load.

8. The test pile may or may not be a production pile, as specified by the engineer.

9. Contractor guarantees that should the test pile fail to give acceptable results, he will modify his design and install and test another pile at his expense. He also guarantees that he will repair or replace at his own expenses all structural damage caused by inability of his piles to support the working loads satisfactorily for a period of two years.

END OF SECTION 31.63.33
SECTION 32.10.00

ASPHALT CONCRETE PAVEMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Asphaltic concrete pavement required for this work is indicated on the drawings and includes, but is not necessarily limited to:

1. Final preparation of subgrade.
3. Asphalt surfacing materials.

B. Related Work Described Elsewhere:

1. Grading: Section 31.22.10.
2. Excavation, Backfilling, Compaction: Section 31 22 00.

1.02 QUALITY ASSURANCE

A. Qualifications of Workmen:

1. Provide at least one person who shall be thoroughly trained and experienced in the skills required, who shall be completely familiar with the design and application of work described for this section, and who shall be present at all times during progress of work of this section to direct all work performed under this section.

2. For actual finishing of asphaltic concrete surfaces and operation of the required equipment, use only personnel who are thoroughly trained and experienced in the skills required.

1.03 PRODUCT HANDLING

A. Protection: Use all means necessary to protect asphaltic concrete pavement materials before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Designer and at no additional cost to the Owner.
1.04 DUST CONTROL

A. Use all means necessary to prevent spread of dust during performance of the work of this section. Thoroughly moisten all surfaces as required to prevent dust from being a nuisance to the public.

PART 2 - PRODUCTS

2.01 MINERAL AGGREGATE (STONE) BASE

Tennessee Department of Highways Specifications 903.5, Class A, Grading D, and Specifications Section 303, as adopted March 1, 1995, with Addendums.

2.02 PRIME COAT AND TACK COAT

Bituminous surface treatments shall meet the provisions of Section 402 and 403 of the Tennessee Highway Department Specifications, Revised March 1, 1995.

2.03 HOT-MIX ASPHALT SURFACE COURSE


2.04 HOT-MIX ASPHALT BINDER COURSE


PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Inspection:

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that asphaltic concrete pavement shall be installed in strict accordance with the original design, all pertinent codes and regulations, and all pertinent portions of the referenced standards.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Designer.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 FINAL PREPARATION OF SUBGRADES

A. Refer to drawings for pavement thickness and construction.
B. Subgrade: Constructed to elevations shown on drawings, within a tolerance of 0.10 foot plus or minus under Section 31.22.00, by General Contractor.

1. Inspect and perform finish grading of subgrade (if required) to the required profiles and grade under this section.

2. Designer and Contractor shall be informed of deficiencies in the constructed profiles and grade under this section.

C. Aggregate Base Course: Place aggregate base material in compacted layers not more than 4" thick. Compact to not less than 100% of maximum dry density, ASTM D 698, Standard Proctor and construct according to Tennessee Highway Specifications.

D. Prime Coat: Uniformly apply at rate of 0.20 to 0.50 gallon per square yard cover compacted and clean sub-base surface. Do not flood the surface. Allow to cure and dry. Blot excess with stone chips or sand.

E. Hot Mix Asphalt Surface Course: Place surface course on prepared surface, spread and strike-off using paving machine. Compact with power driven steel roller weighing not less than 4-tons and according to Tennessee Highway Specifications. Thickness of course to be as shown on drawings. Compact to no less than 92% of its maximum theoretical density.

F. Surface Smoothness: The hot-mix asphalt surface course shall be checked for smoothness with a 10' foot straight edge and a deviation greater than 3/8" will not be accepted.

3.03 PROTECTION

A. Protect from traffic during all operations and until the surface course is thoroughly set and cured.

3.04 FINISH TOLERANCES

Finish all surfaces to the following tolerances:

A. Asphalitic Concrete Plus or Minus 0.05 feet at any point from surfacing: Line and grade shown on the drawings.

3.05 CONCRETE CURBS

A. Certain curbs to be constructed of concrete as shown on drawings. Concrete specifications to be same as given in "Concrete" section of the specifications.

END OF SECTION 32.10.00
SECTION 32.16.00
CONCRETE CURBS AND WALKS

PART 1 GENERAL
1.01 SECTION INCLUDES

A. All sidewalks, steps, and ramps shall be 4000 psi cast in place concrete with 2" to 4" slump. Concrete shall be 5" thick. Entrained air to be 3% to 6%.

B. Provide light broom finish with smooth troweled joints.

C. Apply two coats of concrete sealer.

D. Comply with Section 03.30.00 for concrete and reinforcement requirements.

E. Provide construction joints every 4 – 6 feet on center or as shown on drawings. Provide expansion joints every 28 to 30 feet on center, maximum. Construct contraction joints to depth equal to at least 1/4 concrete thickness. Use premolded joint filler for expansion joints. See caulking section for non-tractions self leveling joint caulking.

END OF SECTION 32.16.00
SECTION 32.16.24

BRICK PAVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provide 2-1/4" X 4" X 8" solid paving brick complying with ASTM C902, Weather Class SX, Traffic Type I, Application PX. Brick shall have an average compressive strength of 10,500 psi minimum, cold water absorption of not more than 4% after 24 hour submersion, and not more than 0.5% loss in dry weight with no breakage after 100 cycles of freeze thaw test.

B. Pavers shall be set in a concrete mortar bed, over a cast in place concrete sub-slab.

C. Joint filler shall consist of Portland cement with prepared color added and sand. Color shall be as selected by Designer.

END OF SECTION 32.16.24
SECTION 32.17.23

PAVEMENT MARKING

PART 1 GENERAL
1.01 PURPOSE

A. Provide pavement marking for parking lines, handicap symbols, and other traffic control designations. Parking lines shall be 4" wide. Paint shall be chlorinated rubber paint, equal to Pittsburgh Paints Traffic and Zone Marking Paint. Colors are selected by Designer.

END OF SECTION 32.17.23
SECTION 32.32.23
SEGMENTAL RETAINING WALL SYSTEMS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Work shall consist of designing, furnishing all materials, labor, equipment, and supervision and placement of a segmental retaining wall system in accordance with these specifications and in reasonably close conformity with the lines, grades, design and dimensions shown on the plans or as established by the Owner or Owner’s Engineer.

1.02 RELATED WORK

A. Excavation, Backfilling & Compaction: Section 31.23.00.
B. Sub-Surface Conditions: Section 32.23.00.

1.03 REFERENCE STANDARDS

A. Engineering Design:

1. NCMA Design Manual for Segmental Retaining Walls.
2. NCMA TEC 2-4: Specifications for Segmental Retaining Wall Units.
3. NCMA SRWU-1: Determination of Connection Strength Between Geosynthetics and Segmental Concrete Units.
4. NCMA SRWU-2: Determination of Shear Strength Between Segmental Concrete Units.

B. Segmental Retaining Wall Units:

1. ASTM C 140: Sampling and Testing Concrete Masonry Units.
2. ASTM C 1262: Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units.

C. Geosynthetic Reinforcement:


100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
3. GRI GG-1: Single Rib Geogrid Tensile Strength.
5. GRI GG-5: Geogrid Pullout.
6. GRI GT-6: Geotextile Pullout.

D. Soils:

2. ASTM D 422: Gradation of Soils.
4. ASTM D G51: Soil pH.

E. Drainage Pipe:


F. Where specifications and reference documents conflict, the Owner’s Engineer shall make the final determination of applicable document.

1.04 APPROVED SEGMENTAL RETAINING WALL SYSTEMS

A. Suppliers of segmental retaining wall systems shall have demonstrated experience in the construction of similar size and types of segmental retaining walls on previous projects, and shall be approved by the Owner’s Engineer. The supplier must be approved prior to Bid opening.

B. Approved Manufacturers: Keystone, Versa-Lok, Rockwood Retaining Walls, Allan Block, Cornerstone.

1.05 SUBMITTALS

A. Material Submittals: The Contractor shall submit manufacturer’s certifications, 30 days prior to the start of work, stating that the SRW units, the geosynthetic reinforcement, and the drainage aggregate meet the requirements of Section 2 of this specification. The Contractor shall provide a list of successful projects with references showing that the installer for the segmental retaining wall is qualified and has a record of successful performance.
B. Design Submittal: The Contractor shall submit three (3) sets of detailed design calculations, construction drawings, and shop drawings for approval at least 60 days prior to the beginning of reinforced segmental retaining wall construction. A detailed explanation of the design properties for the geosynthetic reinforcements shall be submitted with the design. Design shall be in accordance with reference standards in paragraph 1.03.A. All computer generated calculations and drawings shall be prepared and sealed by a Professional Engineer, Licensed in the State of Tennessee.

1.06 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall inspect the materials upon delivery to assure that proper type and grade material has been received.

B. The Contractor shall store and handle all materials in accordance with manufacturer's recommendations and in a manner to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping or other causes. Damaged material shall not be incorporated into the Retaining Wall.

PART 2 – MATERIALS

2.01 SEGMENTAL RETAINING WALL UNITS

A. SRW units shall be machine formed, Portland Cement concrete blocks specifically designed for retaining wall applications. SRW units currently approved for this project are:

1. VERSA-LOK Retaining Wall Units as manufactured by General Shale Products Corp.

2. Other products shall be submitted for approval.

B. Color of SRW units shall be as selected by the Architect from the manufacturer's standard colors.

C. Finish of SRW units shall be split face.

D. SRW unit faces shall be of straight geometry.

E. SRW unit height shall be six (6") inches.

F. SRW units (not including aggregate fill in unit voids) shall provide a minimum weight of 105 psf wall face area.

G. SRW units shall be solid through the full depth of the unit.

H. SRW units shall have a depth (front face to rear) to height ratio of 2:1, minimum.

100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
I. SRW units shall be interlocked with connection pins, designed with proper setback to provide 8:1 vertical to horizontal batter (a 7 degree cant from vertical).

J. SRW units shall be capable of being erected with the horizontal gap between adjacent units not exceeding 1/8” inches.

K. SRW units shall be capable of providing overlap of units on each successive course so that walls meeting at corner are interlocked and continuous. SRW units that require corners to be mitered shall not be allowed.

L. SRW units shall be capable of providing a split face, textured surface for all vertical surfaces that will be exposed after completion of wall, including any exposed sides and backs of units.

M. SRW units shall be sound and free of cracks or other defects that would interfere with the proper placing of the unit or significantly impair the strength or permanence of the structure. Cracking or excessive chipping may be grounds for rejection. Units showing cracks longer than 1/2” shall not be used within the wall. Units showing chips visible at a distance of 30 feet from the wall shall not be used within the wall.

N. Concrete used to manufacturer SRW units shall have a minimum 28 days compressive strength of 3,000 psi and a maximum moisture absorption rate, by weight, of 8% as determined in accordance with ASTM C1372. Compressive strength test specimens shall conform to the saw-cut coupon provisions of ASTM C140.

O. SRW units’ molded dimensions shall not differ more than ± 1/8” inch from that specified, in accordance with ASTM C1372.

2.02 SEGMENTAL RETAINING WALL UNIT CONNECTION PINS

A. SRW units shall be interlocked with connection pins approved by the block manufacturer. The pins shall consist of glass-reinforced nylon made for the expressed use with the SRW units supplied.

2.03 GEOSYNTHETIC REINFORCEMENT

A. Geosynthetic reinforcement shall consist of geogrids or geotextiles manufactured as a soil reinforcement element. The manufacturers/suppliers of the geosynthetic reinforcement shall have demonstrated construction of similar size and types of segmental retaining walls on previous projects.

B. The geosynthetic type must be approved prior to bid opening. Geosynthetic types currently approved for this project are:

1. VERSA-Grid Geogrids.
C. The type, strength, and placement location of the reinforcing geosynthetic shall be as determined by the Wall Design Engineer, as shown on the final, P.E. sealed retaining wall plans.

2.04 LEVELING PAD

A. Material for leveling pad shall consist of compacted sand, gravel, or combination thereof (USCS soil types GP, GW, SP, & SW) and shall be a minimum of 6" inches in depth. Lean concrete with a strength of 200-300 psi and three (3") inches thick maximum may also be used as a leveling pad material. The leveling pad should extend laterally at least a distance of 6" inches from the toe and heel of the lowermost SRW unit.

2.05 DRAINAGE AGGREGATE

A. Drainage aggregate shall be angular, clean stone or granular fill meeting the following gradation as determined in accordance with ASTM D422:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 inch</td>
<td>100</td>
</tr>
<tr>
<td>3/4 inch</td>
<td>75-100</td>
</tr>
<tr>
<td>No. 4</td>
<td>0-60</td>
</tr>
<tr>
<td>No. 40</td>
<td>0-50</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-5</td>
</tr>
</tbody>
</table>

2.06 DRAINAGE PIPE

A. The drainage collection pipe shall be perforated or slotted PVC, or corrugated HDPE pipe. The drainage pipe shall be wrapped with a geotextile to function as a filter.

B. Drainage pipe shall be manufactured in accordance with ASTM D 3034 and/or ASTM D 1248.

2.07 REINFORCED (INFILL) SOIL

A. The reinforced soil material shall be free of debris. Unless otherwise noted on the final, P.E. sealed, retaining wall plans prepared by the Wall Design Engineer, the reinforced material shall consist of the inorganic USCS Soil Types GP, SW, SW, SP, SM, meeting the following gradation, as determined in accordance with ASTM D422:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 inch</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>20-100</td>
</tr>
<tr>
<td>No. 40</td>
<td>0-60</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-35</td>
</tr>
</tbody>
</table>
B. The maximum particle size of poorly-graded gravels (GP) (no fines) should not exceed 3/4" inch unless expressly approved by the Wall Design Engineer and the long-term design strength (LTDS) of the geosynthetic is reduced to account for additional installation damage from particles larger than this maximum.

C. The plasticity of the fine fraction shall be less than 20.

PART 3 – EXECUTION

3.01 SOIL

A. The following soil parameters, as determined by the Owner’s Geotechnical Engineer shall be used for the preparation of the final design:

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Compacted No. 57 Stone</th>
<th>Compacted On Site Soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle of Friction degrees</td>
<td>36</td>
<td>20</td>
</tr>
<tr>
<td>At Rest Pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coefficient, K₀</td>
<td>0.43</td>
<td>0.66</td>
</tr>
<tr>
<td>Active Pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coefficient, Kₐ</td>
<td>0.27</td>
<td>0.49</td>
</tr>
<tr>
<td>Passive Pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coefficient, K₀</td>
<td>NA</td>
<td>2.04</td>
</tr>
<tr>
<td>Unit Weight of Material, pcf</td>
<td>110</td>
<td>125</td>
</tr>
<tr>
<td>Friction Factor (concrete Bearing on Soil)</td>
<td>NA</td>
<td>0.35</td>
</tr>
<tr>
<td>Allowable Soil Bearing Capacity, psf (on approved and Prepared subgrades)</td>
<td>NA</td>
<td>2000</td>
</tr>
</tbody>
</table>

Should the actual soil conditions observed during construction differ from those assumed for the design, design shall be reviewed by the Wall Design Engineer at the Engineer’s direction.

3.02 DESIGN

A. The design analysis for the final, P.E. sealed retaining wall plans prepared by the Wall Design Engineer shall consider the external stability against sliding and overturning, internal stability, and facial stability of the reinforced soil mass and shall be in accordance with acceptable engineering practice and these specifications. The internal and external stability analysis shall be performed in accordance with the “NCMA Design Manual for Segmental Retaining Walls”, using the recommended minimum factors of safety in this manual.
B. External stability analysis for bearing capacity, global stability, and total and differential settlement shall be the responsibility of the Owner and the Owner’s Geotechnical Engineer. Geotechnical Engineer shall perform bearing capacity, settlement estimates, and global stability analysis based on the final wall design provided by the Wall Design Engineer and coordinate any required changes with Wall Design Engineer.

C. While vertical spacing between geogrid layers may vary, it shall not exceed 2.0 feet maximum in the all design.

D. The geosynthetic placement in the wall design shall have 100 percent continuous coverage parallel to the wall face. Gapping between horizontally adjacent layers of geosynthetic (partial coverage) will not be allowed.

3.03 INSPECTION

A. Examine the area and conditions under which the work of this section will be performed. Correct conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Contractor’s field construction supervisor shall have demonstrated experience and be qualified to direct all work at the site.

3.04 EXCAVATION

A. Contractor shall excavate to the lines and grades shown on the project grading plans. Contractor shall take precautions to minimize over-excavation. Over-excavation shall be filled with compacted infill material, or as directed by the Engineer or Architect, at the Contractor’s expense.

B. Contractor shall verify location of existing structures and utilities prior to excavation. Contractor shall ensure all surrounding structures are protected from the effects of wall excavation. Excavation support, if required, is the responsibility of the Contractor.

3.05 FOUNDATION PREPARATION

A. Following the excavation, the foundation soil shall be tested by a qualified testing agency under the requirements of Section 01.41.00.

B. The excavation shall be examined by the Architect or Engineer to assure actual foundation soil strength meets or exceeds the assumed design bearing strength. Soils not meeting the required strength shall be removed and replaced with infill soils, as directed by the Engineer.

C. Foundation soil shall be proof-rolled and compacted to 95% standard Proctor density and tested by the soils testing agency prior to placement of leveling pad materials.
3.06 LEVELING PAD CONSTRUCTION

A. Leveling pad shall be placed as shown on the final, P.E. sealed retaining wall plans with a minimum thickness of 6" inches. The leveling pad should extend laterally at least a distance of 6" inches from the toe and heel of the lower most SRW unit.

B. Granular leveling pad material shall be compacted to provide a firm, level bearing surface on which to place the first course of units. Well-graded sand can be used to smooth the top 1/4" to 1/2" inch of the leveling pad. Compaction will be with mechanical plate compactors to achieve 95% of maximum standard Proctor density (ASTM D 698).

C. Leveling pad material shall be tested by the soils testing agency to verify compaction prior to proceeding with SRW unit installation.

3.07 SRW UNIT INSTALLATION

A. All SRW units shall be installed at the proper elevation and orientation as shown on the final, P.E. sealed wall plans and details or as directed by the Wall Designer. The SRW units shall be installed in general accordance with the manufacturer's recommendations. The specifications and drawings shall govern in any conflict between the two requirements.

B. First course of SRW units shall be placed on the leveling pad. The units shall be leveled side-to-side, front-to-rear and with adjacent units, and aligned to ensure intimate contact with the leveling pad. The first course is the most important to ensure accurate and acceptable results. No gaps shall be left between the front of adjacent units. Alignment may be done by means of a string line or offset from base line to the back of the units.

C. All excess debris shall be cleaned from top of units and the next course of units installed on top of the units below.

D. Two connection pins shall be inserted through the pin holes of each upper course unit into receiving slots in lower course units. Pins shall be fully seated in the pin slot below. Units shall be pushed forward to remove any looseness in the unit-to-unit connection.

E. Prior to placement of next course, the level and alignment of the units shall be checked and corrected, where needed.

F. Layout of curves and corners shall be installed in accordance with the wall plan details or in general accordance with SRW manufacturer's installation guidelines. Walls meeting at corners shall be interlocked by overlapping successive courses.
G. Procedures C. through F. shall be repeated until reaching top of wall units, just below the height of the cap units. Geosynthetic reinforcement, drainage materials, and reinforced backfill shall be placed in sequence with unit installation as described in Section 3.08, 3.09, and 3.10.

**3.08 GEOSYNTHETIC REINFORCEMENT PLACEMENT**

A. All geosynthetic reinforcement shall be installed at the proper elevation and orientation as shown on the final, P.E. sealed retaining wall plan profiles and details, or as directed by the Wall Design Engineer.

B. At the elevations shown on the final plans, (after the units, drainage material, and backfill have been placed to this elevation) the geosynthetic reinforcement shall be laid horizontally on compacted infill and on top of the concrete SRW units, to within one inch of the unit below. Embedment of the geosynthetic in the SRW units shall be consistent with SRW manufacturer’s recommendations. Correct orientation of the geosynthetic reinforcement shall be verified by the Contractor to be in accordance with the geosynthetic manufacturer’s recommendations. The highest strength direction of the geosynthetic must be perpendicular to the wall face.

C. Geosynthetic reinforcement layers shall be one continuous piece for their entire embedment length. Splicing of the geosynthetic in the design strength direction (perpendicular to the wall face) shall not be permitted. Along the length of the wall, horizontally adjacent sections of geosynthetic reinforcement shall be overlapped by a minimum amount of two grid sections.

D. Tracked construction equipment shall not be operated directly on the geosynthetic reinforcement. A minimum of 6" inches of backfill is required prior to operation of tracked vehicles over the geosynthetic. Turning should be kept to a minimum. Rubber-tired equipment may pass over the geosynthetic reinforcement at speeds less than 5 mph.

E. The geosynthetic reinforcement shall be free of wrinkles prior to placement of soil fill. The nominal tension shall be applied to the reinforcement and secured in place with staples, stakes or by hand tensioning until reinforcement is covered by six (6") inches of fill.

**3.09 DRAINAGE MATERIALS**

A. Drainage aggregate shall be installed to the line, grades, and sections shown on the final P.E. sealed retaining wall plans. Drainage aggregate shall be placed to the minimum thickness shown on the construction plans between and behind units (a minimum of one cubic foot for each exposed square foot of wall face unless otherwise noted on the final wall plans).
B. Drainage collection pipes shall be installed to maintain gravity flow of water outside the reinforced soil zone. The drainage collection pipe shall daylight into a storm sewer or along a slope, at an elevation lower than the lowest point of the pipe within the aggregate drain.

3.10 BACKFILL PLACEMENT

A. The reinforced backfill shall be placed as shown in the final wall plans in the maximum compacted lift thickness of 10" inches and shall be compacted to a minimum of 95% of standard Proctor Density (ASTM D 698) at the moisture content within 2% of optimum. The backfill shall be placed and spread in such a manner as to eliminate wrinkles or movement of the geosynthetic reinforcement and the SRW units.

B. Only hand operated compaction equipment shall be allowed within 3’ feet of the back of the wall units. Compaction within the 3’ feet behind the wall units shall be achieved by at least three (3) passes of a lightweight mechanical tamper, plate, or roller.

C. At the end of each day’s operation, the Contractor shall slope the last level of backfill away from the wall facing and reinforced backfill to direct water runoff away from the wall face.

D. At completion of wall construction, backfill shall be placed level with final top of wall elevation. If final grading, paving, landscaping, and/or storm drainage installation adjacent to the wall is not placed immediately after wall completion, temporary grading and drainage shall be provided to ensure water runoff is not directed at the wall nor allowed to collect or pond behind the wall until final construction adjacent to the wall is completed.

3.11 SRW CAPS

A. SRW caps shall be properly aligned and glued to underlying units with a flexible, high-strength concrete adhesive. Rigid adhesives or mortar are not acceptable.

B. Caps shall overhang the top course of units by 3/4" to 1" inch. Slight variation in overhang is allowed to correct alignment at the top of the wall.

3.12 CONSTRUCTION ADJACENT TO COMPLETED WALL

A. Ensure that construction adjacent to the wall does not disturb the wall or place temporary construction loads on the wall that exceed design loads, including loads such as water pressure, temporary grades, or equipment loading. Equipment with wheel loads in excess of 150 psf live load shall not be operated within 10’ feet of the face of the retaining wall during construction adjacent to the wall. Care should be taken to ensure water runoff is directed away from the wall structure until final grading and surface drainage collection systems are completed.

END OF SECTION 32.32.23

100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
SECTION 32.33.00

SITE FURNISHINGS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. General Provisions of the Contract, General and Supplementary Conditions, and Division 1 Specification Sections, General Requirements, apply to this section.

1.02 DESCRIPTION OF WORK

A. Labor, material, equipment, and services necessary to provide pre-fabricated site furnishings, including pre-fabricated planters and seating.

1.03 QUALITY ASSURANCE

A. Coordination: Coordinate accessory locations with other work to avoid interference and to assure proper operation and servicing of accessory units.

B. Uniformity: Provide products of same manufacturer for each type of accessory unit and for units exposed in same areas, unless otherwise acceptable to Architect.

1.04 SUBMITTALS

A. Submit manufacturer’s technical product data and shop drawings for each item. Include installation instructions for accessories which are built-in or connected to other work.

PART 2 – PRODUCTS

2.01 PRODUCTS

A. Benches:

1. As manufactured by SITESCAPES Model No. CITYVIEW – CV1-1010PF, 73" x 34", 275 lbs. metal armor coating. Color: Onyx.

2. Furnish stainless steel bolts where bolts are required by the manufacturer for securing to concrete walks or slab.

B. Bicycle Racks:

1. As manufactured by DERO Bike Racks – Custom Design – 5904 Malcolm Avenue, Suite 100 Minneapolis, MN 55414. Units to be powder coated. Color: Black.

C. Ornamental Fence:


100% DESIGN DEVELOPMENT SUBMITTAL

ISSUED: 3/13/2017
D. Guardrails:
      Provide simple timeless design similar to Montage light industrial.
      Material: Wrought iron.
      Color: Black powder coat.

E. Handrails:
   1. Provide guardrail with separate handrail equal to Manufacturer: Ameristar
      Provide handrails at exterior stairs and ramps as required by Code.
      Handrails to be simple timeless design similar to Montage ornamental fence.
      Material: Wrought iron.
      Color: Black powder coat.

F. Tree Grates:
   1. Tree grates shall be gray iron castings complying with ASTM A48, Class 35, or
      better. Grates shall be equal to #R-8642-A (square) or #R-8622-A (round) as
      manufactured by Neenah Foundry Company.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Examine all areas and surfaces to receive site furnishings prior to beginning installation.
   Begin installation only after finishes have been completed, but prior to final acceptance
   in each area.

B. Install units in locations shown, or if not shown, where directed by the Architect. Install in
   accordance with manufacturer’s written instructions as shown on the drawings or as
   specified herein.

C. All units to be bolted or secured to concrete or in concrete.

3.02 ADJUST AND CLEAN

A. Verify that all components are in place. Clean and polish exposed surfaces, using
   materials and methods recommended by manufacturer of accessory item.

B. Restore all marred or otherwise damaged surfaces to original, unused condition to
   satisfaction of Architect. Replace damaged units when directed by Architect.

C. Adjust any operating parts for smooth, bind-free operation.

END OF SECTION 32.33.00
PART 1 - GENERAL

1.01 SUMMARY

A. Provide complete underground irrigation system as shown on the drawings and as specified here-in. The work includes:
   1. Automatic irrigation systems including piping, fittings, sprinkler heads and accessories.
   2. Valves and fittings.
   3. Controllers and control wire
   4. Testing
   5. Excavating and backfilling irrigation system work.
   6. Associated interior and exterior plumbing, wiring, and accessories to complete the sys-
      tem.
   7. Pipe sleeves.

B. The irrigation system shall be compliant with the latest edition of the State of Tennessee
   Sustainable Design Guidelines. Provide calculations and documentation as requested by the
   Architect for the Landscape Irrigation Water Efficiency Credit as required to demonstrate that the
   system utilizes at least 50% less water than a conventional system.

1.02 RELATED REQUIREMENTS

   1. Landscape Grading: Section 32.91.19
   2. Seeding: Section 32.92.19
   3. Sodding: Section 32.92.23
   4. Trees, shrubs, and ground covers: Section 32.93.00

1.03 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or
   for remote-control, signaling power-limited circuits.

B. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves.
   Piping is under pressure during flow.

C. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.

D. Main Piping: Downstream from point of connection to water distribution piping to, and including,
   control valves. Piping is under water-distribution-system pressure.

1.04 QUALITY ASSURANCE

A. Acceptable Manufacturers:
   1. Rainbird Sales, Inc.,
   2. Hunter Industries, Inc.
   3. The Toro Company

B. Provide underground sprinkler irrigation systems as a complete unit with brand name goods pro-
   duced by a single acceptable manufacturer, including heads, valves, piping circuits, controls and
   accessories.

C. Installer's qualifications: The firm shall have a minimum of 3 years experience with a satisfactory
   record of performance for installing irrigation systems of comparable size and quality. The firm
   shall be a contractor licensed by the State of Tennessee Board of Licensing Contractors. The Con-
   tractor shall hold one or more of the following classifications: BC-29, HRA-E(2) or S (Lawn and
Golf Course Sprinkler Systems); and have a monetary limit of $250,000 or more. Workmanship shall be of the highest quality. It is also preferred, but not mandatory, the contractor hold a C.I.C. certification from the Irrigation Association.

D. Materials, equipment, and methods of installation shall comply with all applicable codes and standards including:
   4. The Irrigation Association, (IA).

E. Excavating, backfilling, and compacting operations: Comply with requirements as specified here-in.

F. Obtain in writing Landscape Architect's acceptance of installed and tested irrigation system.

G. American Society of Safety Engineers:
   1. ASSE 1013 – Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
   2. ASSE 1015 – Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies.

H. 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.

1.05 SUBMITTALS

A. Submit the following in accordance with Section 01300.
   1. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   2. Wiring Diagrams: For power, signal, and control wiring.
   3. Shop Drawings: Shop drawings for the complete irrigation system. Include piping layout and details illustrating location and types of factory sprinkler heads and control valves, control systems and wiring, and list of fittings.
   4. Zoning Chart: Show each irrigation zone and its control valve.
   5. Material Samples: Furnish upon request.
   6. Prior to final inspection and before irrigation system acceptance, submit written operating and maintenance instructions including schedule of operation with run times and days for each station. Obtain Landscape Architect's approval for the same in writing.
   7. Provide to Owner's appointed maintenance personnel instruction in proper use and monitoring of irrigation system. Submit with Close-Out Documents statement signed by Contractor and Owner's representative that Contractor has provided specified training.
   8. Warranties for each component warranted by manufacturer.
   9. Provide irrigation system record drawings:
      a. Legibly mark drawings to record actual construction.
      b. Indicate horizontal and vertical locations, referenced to permanent surface improvements using planting plans or other appropriate drawings as base sheets. Submittals shall include one mylar reproducible of each sheet and three (3) sets of prints.
      c. Identify field changes of dimension and detail and changes made by Change Order.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Deliver irrigation system components in manufacturer's original undamaged and unopened containers with labels intact and legible.

B. Deliver plastic piping in bundles, packaged to provide adequate protection of pipe ends, both threaded or plain.

C. Store and handle materials to prevent damage, theft, and deterioration.

D. Provide secure, locked storage for valves, sprinkler heads, and similar components that cannot be immediately replaced, to prevent installation delays.

1.07 PROJECT CONDITIONS

A. The water supply for each area of the site shall be as shown on the Site Utilities and Plumbing drawings or the Irrigation drawings as appropriate.

B. The Contractor shall, at his own expense, locate, excavate and verify the alignment and depth of all known underground utilities as shown or inferred on the drawings. Protect existing utilities, paving, and other facilities from damage caused by irrigation installation operations.

C. Promptly repair damage to adjacent facilities caused by irrigation system work operations. All damage to adjacent facilities resulting from work covered in these specifications will be repaired at the Contractor's expense.

D. Protect new and existing trees, plants, lawns, and other features designated to remain as part of the final landscape work.

E. Promptly repair damage to finish grades, lawn areas and planting caused by irrigation system work operations. All damage to grades, lawns and planting resulting from work covered in these specifications will be repaired at the Contractor's expense.

F. Promptly notify the Landscape Architect in writing of unexpected sub-surface conditions.

G. Coordinate irrigation work with other trades to avoid conflicts and permit all trades to perform their work in a timely manner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General:
   1. Provide only new materials, without flaws or defects and of the highest quality of their specified class or kind.
   2. Provide pipe sizes required. No substitution of smaller pipes will be permitted. Larger sizes may be used subject to acceptance of the Landscape Architect. Remove damaged and defective pipe.
   3. Provide pipe continuously and permanently mark with manufacturer's name or trademark, size schedule and type of pipe, working pressure at 73 degrees F. and National Sanitation Foundation (NSF) approval.

B. Plastic pipe, tubes, fittings, and connections:
   1. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes. Provide one insulated No. 12 solid copper "locator" wire with all water line installations as required.
   2. Saddle and cross fittings are not permitted.
   3. Schedule 80 PVC pipe may be threaded.
   4. Use male adapters for plastic to metal connections. Hand tighten male adapters plus one turn with a strap wrench.
      a. PE Pipe with Controlled ID: ASTM F 771, PE 3408 compound; SIDR 11.5 and SIDR 15.
1) Insert Fittings for PE Pipe: ASTM D 2609, nylon or propylene plastic with barbed ends. Include bands or other fasteners.

b. PE Pipe with Controlled OD: ASTM F 771, PE 3408 compound, SDR 11.
   2) PE Socket-Type Fittings: ASTM D 2683.

c. PE Pressure Pipe: AWWA C906, with DR of 7.3, 9, or 9.3 and PE compound number required to give pressure rating not less than [160 psig (1100 kPa)] [200 psig (1380 kPa)].
   2) PE Socket-Type Fittings: ASTM D 2683.

d. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedules 40 and 80.
   1) PVC Socket Fittings: ASTM D 2466, Schedules 40 and 80.
   2) PVC Threaded Fittings: ASTM D 2464, Schedule 80.
   3) PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.

e. PVC Pipe, Pressure Rated: ASTM D 2241, PVC 1120 compound, SDR 21 and SDR 26.
   1) PVC Socket Fittings: ASTM D 2467, Schedule 80.
   2) PVC Socket unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.

C. Sprinkler heads, valves, and associated equipment:
   1. In order to afford the Owner their best possible warranty support as stated by the manufacturer and herein, all irrigation brand name goods (i.e. valves, controllers, heads, etc.) shall be purchased from an authorized distributor recognized by the manufacturer to provide warranty support for the geographic location of the project.
   2. Sprinkler Head: Manufacturer's pop-up unit with built-in check valve designed to provide uniform coverage over entire area of spray shown on drawings as follows:
      a. Flush Surface: Fixed pattern, with screw-type flow adjustment and precipitation rates matched across patterns and sets.
      b. Bubbler: Fixed pattern, with screw-type flow adjustment.
      c. Shrubbery: Fixed pattern, with screw-type flow adjustment and precipitation rates matched across patterns and sets.
      d. Nozzles for Pop-up Spray Sprinklers:
         1) Fixed Pattern Spray Nozzles: The nozzle shall be constructed of corrosion and UV-resistant plastic and have a stainless steel screw to adjust the flow and radius of throw from the nozzle. It shall be compatible with a plastic screen that protects the nozzle against debris in the water. The nozzle base shall be color coded to differentiate between the radius options.
         2) Adjustable Arc Spray Nozzles: The nozzle shall be constructed of corrosion and UV-resistant plastic and have a stainless steel screw to adjust the flow and radius of throw from the nozzle. It shall be compatible with a plastic screen that protects the nozzle against debris in the water. The nozzle base shall be color coded to differentiate between the radius options.
         3) Utilize Fixed Pattern Spray Nozzles, (Rain Bird U-Series), whenever possible with minimal over-spray. Adjustable Arc Nozzles (Rain Bird
HE-VAN Series) are to be utilized only when necessary to mitigate over-spray onto adjacent paving or structures.

e. Pop-up Spray Body for Spray nozzles:

1) The sprinkler shall be available with a 4-, 6-, or 12-inch pop-up stroke, depending on the body specified, to bring the nozzle into a clean environment. The sprinkler shall have a factory-installed drain check valve capable of checking up to 10 feet in elevation change. The sprinkler shall have the words “CHECK VALVE” or “SAM” stamped in white lettering on the body cap, (Rain Bird 1800-SAM-PRS)

2) The sprinkler shall have a standard pressure-regulating device as an integral part of the pop-up riser. This regulator will prevent fogging or misting of the nozzle spray pattern by maintaining a constant nozzle outlet pressure of 30 PSI with inlet pressures of up to 100 PSI, regardless of the nozzle installed. (Rain Bird 1800-SAM-PRS)

3) The body of the sprinkler shall be constructed of corrosion and UV-resistant, heavy-duty A.B.S. The riser of the sprinkler shall be constructed of abrasion and UV-resistant A.B.S. and shall be adjustable for pattern alignment. The riser shall be compatible with female threaded nozzles and shall have a stainless steel spring for positive retraction when irrigation is complete.

4) The sprinkler shall have a pressure-activated, multi-function, UV stable wiper seal that will clean debris from the pop-up stem while it retracts. This seal shall prevent the sprinkler from sticking in the up position and be capable of sealing the sprinkler riser stem to the sprinkler cap under normal operating pressures. The seal shall be removable from the cap for easy service and shall be replaceable.

f. Pop-up Rotor Sprinklers:

1) Gear or turbine drive, full circle and adjustable part circle type.

2) The sprinkler shall be available with eight (8) standard nozzles discharging from 1.2 to 9.8 GPM, or four (4) low-angle nozzles discharging from 1.6 to 4.7 GPM. There shall also be one set of specialty nozzles available: A short distance set discharging from .36 to 3.1 GPM. In addition, the rotor shall have MPR nozzle sets available from 25’ to 35’ radius, with a precipitation rate of .60”/hr, to allow for matched precipitation rates and for use with simultaneous operation of the Rain Bird Rotary Nozzles.

3) The sprinkler shall have radius adjustment capabilities by means of a stainless-steel nozzle retainer/radius adjustment screw.

4) The sprinkler shall be both full-circle and adjustable part-circle operation in a single unit. The sprinkler shall be minutely adjustable from 40° to 360°.

5) The sprinkler shall be equipped with a self-adjusting stator to ensure constant rotation speed regardless of nozzle installed.

6) The sprinkler shall have a non-strippable drive mechanism that allows the nozzle turret to be turned during operation, without damage. It shall also have an automatic arc return feature that returns the nozzle turret to its proper orientation if it is turned outside its intended arc of coverage, as well as a brass shaft connecting the nozzle turret to the drive assembly which is designed to provide tremendous side impact resistance. (Rain Bird 5505 & 8005 series)
7) The sprinkler shall have a minimum of 4-inch pop-up stroke (measured from the top of the sprinkler body to the center of the nozzle) to bring the rotating nozzle turret into a clean environment. The sprinkler shall be available as an aboveground shrub head, a 6-inch pop-up, and as a 12-inch pop-up. (Rain Bird 5000 series with SAM-PRS option)

8) The body and riser of the sprinkler shall be constructed of corrosion resistant, impact resistant, heavy-duty A.B.S. It shall have a stainless steel spring for positive retraction of the riser when irrigation is complete. When specified, the 4 and 6-inch models shall have the riser and nozzle-turret assembly encased in stainless steel.

g. Rotator nozzles:

1) The sprinkler shall be of the viscous fluid brake rotary type and be a multi-stream, multi-trajectory rotating stream sprinkler.

2) The sprinkler shall produce and maintain a matched precipitation rate no greater than 0.6” per hour throughout the arc adjustment range and radius adjustment range, (up to 25% of radius reduction), when spaced at 50% of wetted diameter.

3) Full or part circle sprinklers shall be capable of up to 25% radius reduction using a stainless steel radius adjustment screw. The radius reduction screw shall have a slip clutch mechanism to prevent internal damage if turned past the minimum or maximum radius settings. The radius reduction screw shall reduce the pressure and flow upstream of the adjustable orifice thereby maintaining stream integrity.

4) Part circle sprinklers shall have arc adjustment capabilities using a stainless steel ring. The adjustment ring shall be effective only while the sprinkler is popped up and shall be ineffective while the sprinkler is popped down. When turned past the minimum or maximum arc limits the adjustment mechanism shall have a ratcheting action to prevent internal damage.

5) This same ratcheting action shall allow the orientation of the left edge of the variable arc when installed on a fixed riser or in a popup body. This is independent of and in addition to any ratchet that may exist in a popup body.

6) The sprinkler itself shall pop-up at approximately 15 psi of water pressure. Upon cessation of water pressure, the sprinkler itself shall retract. When installed in a pop-up body the sprinkler itself shall pop-up after the body stem is almost fully extended. Upon decreasing pressure the sprinkler itself shall pop-down before the pop-down of the body stem is complete.

7) The sprinklers adjustable orifice shall be manufactured from polyurethane and acetyl plastic materials for durability.

8) The sprinkler shall be fitted with a detachable filter.

h. Pop-up Spray Body for Rotator Nozzles:

1) The sprinkler shall be available with a 4-, 6-, or 12-inch pop-up stroke, depending on the body specified, to bring the nozzle into a clean environment. The sprinkler shall have a factory-installed drain check valve capable of checking up to 14 feet in elevation change.

2) The sprinkler shall have a standard pressure-regulating device as an integral part of the pop-up riser. This regulator will provide optimal distribution uniformity of the Rotator nozzles by maintaining a constant
outlet pressure of 40-45 PSI with inlet pressures of up to 100 PSI, regardless of the rotator installed.

3) The body of the sprinkler shall be constructed of corrosion and UV-resistant, heavy-duty A.B.S. The riser of the sprinkler shall be constructed of abrasion and UV-resistant A.B.S. and shall be adjustable for pattern alignment. The riser shall be compatible with female threaded nozzles and shall have a stainless steel spring for positive retraction when irrigation is complete.

4) The sprinkler shall have a pressure-activated, multi-function, UV stable wiper seal that will clean debris from the pop-up stem while it retracts. The seal shall be molded around a rigid plastic ring to prevent seal deformation. This seal shall prevent the sprinkler from sticking in the up position and be capable of sealing the sprinkler riser stem to the sprinkler cap under normal operating pressures. The seal shall be removable from the cap for easy service and shall be replaceable.

3. Master valves shall be 200 PSI-rated globe style valve, low power solenoid, normally closed fiberglass filled nylon body and bonnet with low flow, low pressure operating capabilities having brass flow control stem, manual open/close control, nylon reinforced rubber diaphragm and manual internal and external bleed.

4. Manual circuit valves of 3’ or less shall be globe valves of brass and rated for 200 psi and come complete with handle. One valve shall be installed on supply side of each automatic circuit valve.

5. Automatic circuit valves:
a. The electric remote control valve shall be a normally closed 24 VAC 50/60 Hz (cycles/sec) solenoid actuated globe pattern design.
b. The valve pressure rating shall not be less than 200 psi (13.80 bar).
c. The valve body shall be constructed of heavy-duty glass-filled UV-resistant nylon and have stainless steel studs and flange nuts; diaphragm shall be of nylon reinforced nitrile rubber.
d. The valve shall have both internal and external manual open/close control (internal and external bleed) to manually open and close the valve without electrically energizing the solenoid.
e. The valve’s internal bleed shall prevent flooding of the valve box.
f. The valve shall house a fully-encapsulated, one-piece solenoid. The solenoid shall have a captured plunger with a removable retainer for easy servicing and a leverage handle for easy turning. This 24 VAC 50/60 Hz solenoid shall open with 19.6 VAC minimum at 200 psi (13.80 bar). At 24 VAC, average inrush current shall not exceed 0.41 amps. Average holding current shall not exceed 0.28 amps.
g. The valve shall have a brass flow control stem for accurate manual regulation and/or shut-off of outlet flow.
h. The valve must open or close in less than 1 minute at 200 psi (13.80 bar), and less than 30 seconds at 20 psi (1.38 bar).
i. The PESB valve shall have a self-cleaning stainless steel screen designed for use in dirty water applications.
j. The valve construction shall be such as to provide for all internal parts to be removable from the top of the valve without disturbing the valve installation.
k. Optional Feature Specification:

1) PRS-D Pressure Regulating Module:
l. 100PEB-PRS-D 100PESB-PRS-D
m. 150PEB-PRS-D 150PESB-PRS-D
n. 200PEB-PRS-D 200PESB-PRS-D
o. When so indicated on the design, the 1”, 11⁄2” and 2” electric remote control plastic valves shall have a pressure regulating module (PRS-D) capable of regulating outlet pressure between 15 and 100 psi (3 psi) (1,04 and 6,90 bar (0,21 bar)).
p. The PRS-D module shall have an adjusting knob for setting pressure and Schrader valve connection for monitoring pressure. The pressure shall be adjustable from the PRS-D when the valve is internally manually bled or electrically activated.
  1) Non-Potable Flow Control Handle *
q. PEB-NP-HAN1 - Fits 1”
r. PEB-NP-HAN2 - Fits 11⁄2” and 2”
s. When so indicated on the design, the valve shall have a purple flow control handle to indicate to the user that non-potable water is being used. There shall be no difference between the black and purple handles except for the color.
6. Quick coupling valves shall be heavy-duty two piece brass construction with locking rubber cover.
7. Water hammer arrester, if required, shall be compatible with the systems and system operating pressures and flow rates as shown on the drawings.

D. Drip Irrigation:
1. Control Zone Kits and Sensors:
   a. General:
      1) Control zone kit assemblies for drip irrigation zones must include a valve, filtration and pressure regulation to meet the flow requirements of the zone. Where necessary a check valve shall also be installed.
      2) Components shall be sized according to the hydraulic demands of the system.
   b. Irrigation Control Zone Kits with Valve, Pressure Regulator and Filter:
   c. Irrigation Control Zone Kit for zones with flows from .5 to 15 GPM (30 to 900 GPH)
      1) The valve shall be available in a globe configuration and shall be equipped with a flow control mechanism with removable handle that will regulate flow from full on to completely off.
      2) The body and bonnet shall be molded of non-corrodible, PVC, rated to 150 PSI (10.3 bar, 1034 kPa). Models with flow control capability shall have bonnets molded out of glass-reinforced nylon. The diaphragm assembly shall be of molded construction. The diaphragm shall be equipped with a serrated disc to screen water-borne contaminants, preventing them from reaching the metering area, and bleed ports of the valve. A perforated diaphragm support ring shall fit into the valve body just below the diaphragm to relieve stress on the diaphragm when the valve is closed. The bonnet bolts shall be serviceable with a slotted screwdriver, Phillips screwdriver, or a hex wrench, and shall be held captive in the bonnet when the bonnet is removed from the valve body.
      3) The standard solenoid shall be a 24 VAC unit with a 370mA inrush current and 190mA holding current at 60 cycles or a 475 mA inrush
current and 230 mA holding current at 50 cycles. When specified, the unit shall be equipped with a DC latching solenoid for use with battery-operated controllers. The solenoid shall be an encapsulated, one-piece unit with captive plunger. It shall be equipped with manual internal and external bleed capability to release the upper chamber water to the downstream piping or to atmosphere, allowing the valve to open.

4) The valve shall carry a two-year, exchange warranty.

5) The Pressure Regulator shall provide pressure regulation for protection of downstream components of a drip irrigation system. The pressure regulating device is a normally open device that allows full flow with little pressure loss unless the inlet pressure is greater than the pre-set level. As the inlet pressure increases above the preset level it compresses a spring and begins to reduce the downstream pressure. The pressure regulator shall have a preset outlet pressure of approximately 25 or 40 psi (1.7 or 2.8 bar), depending on model specified, and shall have 1-inch female threaded inlet and outlet.

6) The Filter shall have a body and cap that are made of glass-filled, UV-resistant polypropylene, with 150 psi (10.3 bar) pressure rating. The filter screen shall be constructed of durable stainless steel mesh attached to a polypropylene frame. The standard 150-mesh screen shall be serviceable for cleaning purposes by unscrewing the cap from the body and removing the filter element. The design shall be of a compact “Y” body and cap configuration. The 1” filter body shall have a 1” male threaded inlet and outlet.

7) The control zone kits shall have an automatic irrigation control valve.

E. Inline Emitter Drip Tubing, Pressure-Compensating with Check Valve (for sloped areas):

a) The inline emitter shall be welded to the inner circumference of the polyethylene tubing. The inline emitter shall have dual outlet ports, 180° apart, ensuring only one port has contact with the ground when the tubing is installed at grade and mulched over.

b) Drip line emitters shall pressure compensate by lengthening the emitter’s turbulent flow path. The emitter shall be cylindrical in shape and provide surface area for filtration throughout 360° of its outer circumference. This increased filtration surface area shall assure that the water that enters the inline emitter can always come from the upper half, or cleanest part of the flow path in the polyethylene tubing regardless of how the inline tubing lays on the ground.

c) Drip tubing shall conform to a Nominal .5575” Inside Diameter, Nominal .045” Wall Thickness and shall be compatible with all industry standard 17MM fittings (Both barbed and compression).

d) Drip tubing shall have factory installed, check valve and pressure-compensating, inline emitters with spacing as indicated on drawings.

e) The flow rate from each installed inline emitter shall be a consistent [0.4], [0.6] or [1.0] gallons per hour (1.35, 2.35, or 3.75 liters per hour [LPH]) or when inlet pressure is between 15 and 50 psi (1.0 to 3.5 bar).

f) OPERATIONAL PRESSURE RANGE OF 15-50PSI (1.0-3.5
F. Inline emitter drip tubing with standard or sub-surface emitter tubing (Rain Bird XF-SDI series):
   a. Pressure compensating with Copper Shield
   b. The inline emitter shall be welded to the inner circumference of the polyethylene tubing. The inline emitter shall have dual outlet ports, 180° apart, ensuring only one port has contact with the ground when the tubing is installed at grade and mulched over.
   c. Emitter shall pressure compensate by lengthening the emitter’s turbulent flow path. The emitter shall be cylindrical in shape and provide surface area for filtration throughout 360° of its outer circumference. This increased filtration surface area shall assure that the water that enters the inline emitter can always come from the upper half, or cleanest part of the flow path in the polyethylene tubing regardless of how the inline tubing lays on the ground.
   d. Dripline shall have factory installed, pressure-compensating, inline emitters installed every [12] or [18] or [24] inches. OR
   e. Dripline shall have factory installed, pressure-compensating, inline emitters with spacing as indicated on drawings.
   f. The flow rate from each installed inline emitter shall be a consistent [0.6] or [0.9] gallons per hour when inlet pressure is between 8.5 and 60 psi (0.7 to 4.1 bars).
   g. Operating pressure range: 8.5 to 60 psi (0.7 to 4.1 bar).

G. Automatic Control System – Rain Bird IQ2
   1. The irrigation central control system shall be the IQ v2.0 Central Control System™ as hereafter specified and as shown on the drawings. The system shall be fully programmable, providing the operator with absolute and full control of the entire control system. The system shall provide a degree of flexibility such that, in effect, anything that could be done at the satellite controller shall be capable of being done at the central computer.
   2. The system shall have a Windows® graphical user interface (GUI) that allows easy programming and graphical depiction of the satellite controller programming.
   3. The system shall be compatible with the ESP-LXME series traditionally-wired controllers with 1 to 48 station capacity. The system shall also be compatible with ESP-LXD series 2-wire decoder controllers with 1 to 200 station capacity. The system shall have an adjustable satellite controller capacity allowing the customer to expand the system capacity over time.
   4. The system shall allow virtual log-on passwords to administer access privileges to multiple users of the system. The system shall support multiple languages including English, Spanish, French, German, Italian, and Portuguese. The system shall also support user-defined date/time, number, and unit formats.
   5. The system shall allow virtual site configurations, allowing the user to group satellite controllers into a site to simplify common adjustments.
   6. The system shall incorporate a satellite controller dry-run feature that graphically depicts the program operation, showing minute-by-minute program activity, expected flow rates, and the programs/stations operating at any point in time.
   7. The system shall incorporate program adjust values for each satellite controller program. The system shall also include a site-level daily or monthly seasonal adjust percentage that adjusts the station run times for all satellite controllers in the site. The system shall also offer site-level daily or monthly ET value adjustments as an alternative to seasonal adjustment percentage.
8. The controller shall be of a hybrid type that combines electro-mechanical and microelectronic circuitry capable of fully automatic or manual operation. The controller shall be housed in a wall-mountable, plastic locking cabinet suitable for either indoor or outdoor installation. The controller shall support English, Spanish, French, German, Italian and Portuguese languages.

9. The software shall utilize IQNCC Network Communication Cartridges to interface with the system controllers. The cartridges shall be available with internal Phone, GPRS/Cellular, Ethernet, & WiFi modems or RS-232 external modem port. The cartridges installed in the controller shall be field configurable as a Direct, Server, or Client Satellite. The Server satellite shall share its IQ central computer communication link with up to 149 Client satellites and be capable of sharing weather sensors and master valves amongst the 150 satellite controllers.

10. The software shall incorporate a site configuration utility that contacts the satellite controller, reports the hardware configuration and retrieves the configuration and programming data. The software shall verify the satellite hardware configuration has not changed each time it contacts the satellite controller. The controller and IQNCC cartridge firmware shall be upgradeable (reflashed) from the system central computer.

11. The software shall be capable of manually starting a program, test program, or station on any satellite controller. The software shall be capable of overriding the satellite controller Auto/Off dial position and sensor Active/Bypass switch position.

12. Satellite controllers equipped with flow sensors shall provide a learn flow utility to measure the nominal flow rate of each station. The learn flow rate shall be compared to the actual flow sensor flow rate each time the station operates. A user defined percentage above and below the learned flow rate shall be used to determine if the flow rate is problematic. User defined reactions shall be programmable including a diagnose mode where the cause of the problem flow rate is identified and the problem station or water source is shut off. A manual MV water window shall be provided to automatically open the master valve and account for manual watering flow rates without turning off the flow sensing functions of the satellite controller. Both normally closed and open master valves shall be supported. All flow sensing features shall be programmable through the software.

13. The system shall offer user definable station-level priorities and a program-level water window. Stations are selected to operate based on their priority with high priority stations operating first. If a program cannot complete the run time of all stations in the water window the station operation shall be paused and resumed at the start of the next water window.

14. The system shall provide user definable number of simultaneous station to operate per program and for the whole satellite controller. The combination of these features shall be used to automatically shorten the overall operating time of the satellite controller programs. All features listed shall be programmable through the software.

15. The system shall offer optional software feature pack to expand the features of the system. Feature packs shall include: advanced communications; advanced programming; advanced ET; advanced flow sensing. The optional features shall be enabled by a keycode.

16. A system equipped with advanced communication feature pack shall provide automatic communication and email reports. A satellite controller using phone communication shall be capable of initiating communication with the central computer to gather programming changes and sent log data.

17. A system equipped with advanced programming feature pack shall provide satellite controller PIN-code lock-out and 2-way programming. Each satellite shall have minimum of 5 assigned PIN-codes. Lockout options shall include full or partial lockout. All PIN-codes shall be programmed through the software.

18. A system equipped with advanced ET feature pack shall provide automatic program ad-
justment based management allowed depletion scheduling. ET/rain weather sources shall include CIMIS Internet, ETMI Weather Reach, and WSPROLT and WSPRO2 Weather Stations.

19. A system equipped with advanced flow sensing feature pack shall provide minute-by-minute flow logs in a graph comparing actual flow and projected flow. Actual flow totals shall be included in the automated email reports.

20. The IQ v2.0 Central Control System™ shall be as manufactured by Rain Bird Corporation.

H. Automatic Controllers/Satellites:

  a. The controller shall be of a hybrid type that combines electro-mechanical and microelectronic circuitry capable of fully automatic or manual operation. The controller shall be housed in a wall-mountable, plastic locking cabinet suitable for either indoor or outdoor installation. The controller shall support English, Spanish, French, German, Italian and Portuguese languages.

  b. The controller shall be capable of supporting up to 50 stations and shall have a maximum capacity of up to 200 stations.

  c. The controller shall include two-wire diagnostic tools for diagnosis of field wiring, two-wire path and solenoid issues.

  d. The controller shall incorporate an alarm light visible with the controller door in the closed and locked position.

  e. The controller shall interface to decoders capable of controlling one, two, four or six valves per unit. The decoders shall be sealed in such a manner that they shall not be susceptible to moisture or inclement weather and can be buried underground.

  f. The controller shall allow station timing shall from 1 minute to 12 hours. Seasonal Adjust by program shall be available from 0 to 300%. Monthly Seasonal Adjust shall provide automatic monthly adjustments from 0 to 300%.

  g. The controller shall have 4 independent programs with 8 start times each. Flow management shall be available to prevent hydraulic overloading and shall be usable even if flow sensors are not installed. The controller shall have a 365-day calendar and provide program day cycles for custom days of the week, odd, odd no 31, even, and cyclical dates. The user shall be able to set any day or days of the week as a permanent non-watering day. A calendar day off feature shall allow the user pre-program non-watering calendar dates up to 31 days in advance.

  h. The controller shall have Cycle+Soak water management which is capable of operating each station for a maximum cycle time and a minimum soak time to reduce water run-off. Seasonal Adjust % adjustments shall not affect the cycle or soak times.

  i. The controller shall have one local sensor input for connection of a rain or other weather sensor. The controller shall also support up to three additional weather sensor inputs interfaced with sensor decoders. A sensor override switch shall be provided to allow watering even if a sensor is preventing watering. The sensor shall be programmable by station.

  j. The controller shall support up to five independently managed flow sensors interfaced with sensor decoders. The controller shall support up to five flow zones.

  k. The controller shall provide manual station, program, and test program (1 to 10 minutes) operation. A station advance function shall be provided for all manual and automatic operations.

  l. The controller shall incorporate a Rain Delay feature that allows the user to prevent watering for 1 to 14 days.
m. A Contractor Default Program shall be provided to save and restore a base program. A Delayed Recall option shall be provided to allow for automatic program retrieval in 1 to 90 days.

n. The controller shall incorporate a Program Review feature that allows the user to review the program settings, total program run time, and total station run time.

o. The controller shall incorporate a remote port to allow connection and control by a radio remote system.

p. An optional metal wall-mount case and pedestal shall be available to convert the standard plastic case.

q. Optional communication cartridges shall be available to convert the controller to a weather-adjusted Smart controller or computer controlled satellite controller.

r. The controller shall be compatible with the IQ v2.0 Central Control System utilizing IQ-Wi-Fi Network Communication Cartridges. (model IQNCCWF)

s. The controller shall be UL, CUL, CE and C-Tick listed.

I. Valve/Decoder - Controller Communication Wire Path:
   a. The MAXI Type Communication wire for the Two-Wire path(s) shall be double jacketed, two conductor cable intended for control of the Communications Signal and Feed-back Signal for the Rain Bird Central Computerized Control Systems. The cable shall be suitable for direct burial in the earth and also may be installed in ducts or conduits.

b. Conductors: The conductors shall be tin coated (for good mechanical bonding), soft drawn, annealed solid copper conforming to the requirements of ASTM-33. Each conductor shall be insulated with 4/64” (minimum) thick PVC conforming to the requirements of U.L. Standard #493 for thermoplastic insulated underground feeder cables (TYPE UF).

c. The two (2) conductors shall be color coded with one conductor BLACK and the other RED. Both conductors shall be of the same size and shall be of sizes as specified and/or shown on the drawings and a required for the proper operation of the MDC and decoder units connected to it.

d. The wire manufacturer (not the wire broker) shall certify in writing, for each shipment, that the insulated conductors have been tested for and meet the requirements of U.L. Standard #493 for thermoplastic insulated, underground feeder cables (type UF). He shall also certify in writing that the individual conductors have a minimum insulation thickness of 4/64” throughout the entire length of the cable and that the finished cable meets the following requirements of the same standard:

e. Dielectric Voltage Withstand Test = 5000V for 60 seconds.

f. Tension and Elongation Test = 300lbf, no separation

g. Impact Test = 6000V after the impact

h. Crushing Resistance Test = an average of no less than 4500lbf flat, and an average of no less than 1200lbf edge

i. Cold Bend Test = no cracks

j. In addition, each shipment of cable shall included a current dated listing card from the Underwriters, showing the manufacturer’s U.L. I.D. number as evidence that the manufacturer is approved to manufacture thermoplastic insulated underground feeder cable in accordance with the U.L. Standard #493.

k. Outer Jacket: The two (2) conductors shall be laid parallel and covered with a solid color, high density, sunlight resistant polyethylene outer jacket, of the color coding specified and conforming to the requirements of ICEA S-61-402 and
NEMA WC 5. The minimum jacket thickness, when measured at any point in contact with the PVC insulations of the copper conductor and to the outer surface of the outer jacket, shall be 3/64” thick. The outer jacket shall be pressure extruded so as to completely fill the interstices between the two insulated wires.

l. The entire outer polyethylene jacket shall be of the color specified for easy identification of the Two-Wire path. Each two-wire path on the system shall have a different color outer jacket for easy identification after installation and for easily distinguishing between the various two-wire paths on the system. Standard colors for the outer jacket color coding shall be – White, Red, Green, Blue, Yellow, Orange and Black.

m. The Maxi type cable shall be marked on the jacket as follows – MAXI TYPE COMMUNICATION CABLE – 2/C XXAWG, along with the manufacturer’s name and identification number (which is mandatory) and other designations, such as voltage rating, etc. as appropriate. The wire shall not be marked with the name Rain Bird or any other similar designation, except as noted above. The manufacturer shall also certify in writing that the polyethylene outer jacket is of minimum thickness (3/64”) throughout the entire length of the cable and that it does meet and conform to the requirements of ICEA S-61-402 and NEMA WC 5 as outlined above for both electrical and physical properties.

n. The MAXI type communication cable for the two-wire path(s) of the various control systems shall meet or exceed the above specifications in all respects and all written certifications from the manufacturer shall be supplied with the wire as outlined and called for in these specifications.

o. All field connections will be accomplished with wire nuts and will be made water tight and oxidation resistant through the use of 3M Skotch Kast “400” or DBY electrical insulating resin packs. Other brands are not acceptable. Use of sealant without container package is not permissible.

J. Backflow Preventer:
   a. Comply with requirements and codes of local governing authority regarding backflow prevention.
   b. Provide the necessary materials, insulation/draining capabilities, and insulated fiberglass enclosure, dark green in color.
   c. Backflow preventers shall be type suitable for use in high hazard cross connection to potable water system as manufactured by one of the following manufacturer’s:
      1) Watts Regulator Company
      2) Febco
      3) Wilkins.
   d. Reduced pressure backflow preventers shall be ASSE # 1013 and labeled accordingly.
   e. Double check valve assembly backflow preventers shall be ASSE # 1015 and labeled accordingly.
   f. In absence of local codes or requirements, provide double check assembly backflow preventer installed in strict accordance with manufacturer's written instructions.

2.02 MISCELLANEOUS MATERIALS

A. Drainage fill: Clean 3/4" crushed stone.

B. Fill: Clean soil free of stones larger than 2” diameter foreign matter, organic material, and debris.
1. Provide imported fill material as required to complete the work. Obtain rights and pay all costs for imported materials.

2. Suitable excavated materials removed to accommodate the irrigation system work may be used as fill material subject to the Landscape Architect's review and acceptance.

C. Low voltage wire connectors: Socket seal type wire connectors and waterproof sealer, direct burial splice (DBY) by 3M or other approved equal.

D. Valve access box, cover and frame: Tapered enclosure of rigid plastic material with frame and bolt locking cover comprised of fibrous components chemically inert and unaffected by moisture, corrosion and temperature changes as manufactured by Carson, or approved equal.

E. Meter box shall conform to requirements of local utility company.

F. Teflon tape of virgin material and free of deleterious substances.

G. Locator wire: No. 12 solid copper wire with THWN insulation.

H. Concrete: 3000 psi.

I. Soil Separator: Rot resistant polypropylene filter fabric, water permeable, and unaffected by freeze-thaw.

J. Sleeves: Schedule 80 PVC as shown and specified.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine final grades and installation conditions. Do not start irrigation system work until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Install SCH 80 PVC sleeve(s) at each location where pipe crosses pavement as shown on the drawings. Extend sleeves 2'-0" minimum beyond edge of pavement and cap the sleeve at both ends for future use. Where control wire crosses pavement install 2" PVC electrical conduit in same trench with sleeve. Coordinate with other trades to achieve timely installation of sleeves. No pavement patching shall be permitted.

B. Layout and stake the location of each water main, pipe run and all controllers, water meters, sprinkler heads, and sprinkler valves and of pressure regulators, etc. where required. Coordinate layout with planting drawings and other trades to avoid conflicts. Obtain Landscape Architect's acceptance of layout in writing prior to excavating.

C. Notify Landscape Architect in writing of adverse sub-surface conditions. State conditions and submit a proposal for correction including costs. Obtain approval for method of correction prior to continuing work in the affected area. In the event that alternate locations are selected, the Contractor will prepare such areas at no additional expense to the Owner. Irrigation installation shall be performed only by experienced workmen familiar with installation procedures under the supervision of a qualified supervisor.

D. Pressure/Flow Test: Perform calculations according to the Irrigation Association’s 3-Step Method. Provide written calculations to the Owner including the following site information:

1. Static or residual pressure at the POC.
2. Calculation of pressure for “worst case” sprinkler head.
3. Calculation of GPM per zone.

E. Prior to installation, receive approval from General Contractor to proceed with construction.

F. Contractor shall field verify all aboveground and underground utilities prior to start of work.

3.03 INSTALLATION

A. Excavating and backfilling:

1. All excavation shall be considered unclassified excavation and include all materials en-
countered.

2. Excavate trenches of sufficient depth and width to permit proper handling and installation of pipe and fittings. Bottoms shall slope uniformly to low points.

3. Excavate to depths required to provide 3" depth of earth fill or sand bedding for piping unless otherwise indicated.

4. Fill to match adjacent grade elevations with approved earth fill material. Place and compact fill in layers not greater than 8" depth.
   a. Provide approved earth fill or sand to a point 4" above the top of pipe.
   b. Fill to within 6" of final grade with approved excavated or borrow fill materials free of lumps or rocks larger than 1" in any dimension.
   c. Provide clean topsoil fill free of rocks and debris for top 6" of fill.

5. Install main supply lines with a minimum cover of 24" based on finished grades.

6. Install irrigation lines with a minimum cover of 12" based on finished grades.

7. Excavate trenches and install piping during the same working day. Protect open trenches or partially filled trenches open overnight.

8. Provide one cubic foot of drainage fill aggregate around and below each pop-up impact type sprinkler head installed to permit drainage from the sprinkler case.

B. Plastic pipe:

1. Install plastic pipe in accordance with manufacturer's installation instructions. Provide for thermal expansion and contraction. Install one insulated No. 12 solid copper "locator" wire continuous in trench with all pipe installations unless surface features such as sprinkler heads indicate pipe routing. Terminate locator wire in valve box nearest each end of pipe run where locator wire is required.

2. Saw cut plastic pipe. Use a square-in-sawing vice, to ensure a square cut. Remove burrs and shavings at cut ends prior to installation.

3. Slope circuit piping to drain valve at 2" in 10'-0" minimum.

C. Joint Construction:

1. Ream ends of pipes and tubes and remove burrs.

2. Make plastic to metal joints with plastic male adapters.

3. Allow joints to set at least 24 hours before pressure is applied to the system.

4. Remove dirt, and debris from inside and outside of pipe and fittings before assembly.

5. 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:
   a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   b. Damaged Threads: Do not use pipe or pipe fittings with threads that are damaged.

6. Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

7. PE Piping Fastener Joints: Join with insert fittings and bands or fasteners according to piping manufacturer's written instructions.

8. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   a. Plain-End PE Pipe and Fittings: Use butt fusion.
b. Plain-End PE Pipe and Socket Fittings: Use socket fusion.

9. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   b. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   c. PVC Non-pressure Piping: Join according to ASTM D 2855.

D. Sprinklers, fittings, valves, and accessories:

1. Install fittings, valves, sprinkler heads, pressure regulators, and accessories in accordance with manufacturer's instructions.
   a. Install a manual valve on the supply side of each remote control valve.
   b. Make minor adjustments in location of sprinkler heads to avoid plantings and other obstructions. Obtain approval in writing from Landscape Architect if locations shown on plan require alteration.
   c. Provide concrete thrust blocks on 2-1/2" pipe and larger at all 90's, 45's, and tees.

2. System pressures shall be indicated on the drawings at source and at last sprinkler head in circuit.

3. Install sprinkler heads perpendicular to finished grades or on risers where shown.

4. Install pop-up spray, pop-up impact, turbine or gear driven sprinklers with an adjustable double swing joint riser of at least 3 standard 90 degree elbows. Fabricate double swing joint risers of schedule 80 PVC nipples and schedule 40 PVC elbows. The horizontal nipple connected directly into the side of the lateral line shall be a minimum of 3" long. All other nipples of the swing joint riser shall be of length as required for proper installation of the sprinkler head. Polyethylene pipe and proper barbed fittings may also be used to make up swing joints provided maximum flow does not exceed 8 gpm.

5. Obtain Landscape Architect's review and acceptance of height for proposed sprinkler heads, and valves prior to installation.

6. Install sprinklers after hydrostatic test is completed.

7. Locate sprinkler heads to assure proper coverage of indicated areas. Minimum water coverage shall be 95% in turf areas and 85% in other planting areas. Do not exceed spacing distances indicated on the approved shop drawings.

8. Locate part-circle sprinklers to maintain a minimum distance of 4 inches from walls and 2 inches from other boundaries unless otherwise indicated.

9. Install in-ground control valves, manual gate valves, quick coupling valves, and pressure regulators in a valve access box. Electric valves shall have a minimum of 6" clearance between wires and top of box when wiring is complete.

10. Install valve access boxes on a suitable base of gravel completely enclosed with soil separator fabric to provide a level foundation at proper grade and to provide drainage of the access box as shown on the drawings.

11. Seal threaded connections on pressure side of control valves with Teflon tape or approved plastic joint type compound.

12. Install manual gate valve, minimum 1" size, at the end or low point of all dead end laterals to provide for flushing and system drain-down in the fall.

13. Mark all automatic valve box and quick coupler valve box locations with paint dot on top
of nearest curb as directed by the Landscape Architect.

14. Install manual gate valve on the main line, same size as main line, in a valve box on the source side of any roadway crossing.

E. Drip Irrigation Installation:

1. Install freestanding emitters on pipe riser to mounting height indicated.
2. Install manifold emitter systems with tubing to emitters. Plug unused manifold outlets.
3. Install multiple-outlet emitter systems with tubing to outlets. Plug unused emitter outlets.
4. Install drip tubes with direct-attached emitters on ground.
5. Install drip tubes with remote-discharge on ground with outlets on off-ground supports at height indicated.
6. Install off-ground supports of length required for indicated mounted height of device.
7. Install application pressure regulators and filter units in piping near device being protected, and aboveground in control-valve boxes.
8. Install air relief valves and vacuum relief valves in piping, and aboveground in control-valve boxes.

F. Control Wiring Installation:

1. Install electric control cable in the piping trenches wherever possible. Place wire in trench a minimum of 4" vertically above pipe. Install wire with slack to allow for thermal expansion and contraction. Expansion joints in wire may be provided at 200-foot intervals by making 5-6 turns of the wire around a piece of 2" pipe instead of slack. Where necessary to run wire in a separate trench, provide a minimum cover of 12". Tape wire into bundles @ 20 feet on center maximum.
2. Provide sufficient slack at site connections at remote control valves in control boxes, and at all wire splices to allow raising the valve bonnet or splice to the surface without disconnecting the wires when repair is required.
3. Connect master valve to master valve terminal on the controller. Provide one master valve per water supply connection.
4. Connect each remote control valves to decoders as specified.
5. Make wire connections to remote control electric valves, decoders and splices of wire in the field, using wire connectors and sealing cement in accordance with manufacturer's recommendations.
6. Provide tight joints to prevent leakage of water and corrosion build-up on the joint.
7. Install manufacturer's recommended surge protection device between field valves and control unit.

G. Sleeves:

1. Install sleeves for installation of irrigation system prior to paving installation. No cutting and patching of finished surfaces shall be permitted.

H. Water hammer arrester:

1. Install water hammer arrester between tap on main line and circuit valves as required to protect water main and underground irrigation system.

I. Controller:

1. Install controllers as shown on the drawings. Make connections as required to make the automatic control fully operational.
2. Obtain 120V electrical power from locations shown on the drawings.
3. Provide maximum manufacturer’s recommended grounding for the Southeastern U.S.

4. Equipment Mounting: Install wall-mounted controllers on as indicated on drawings for series shown.
   a. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   b. Install anchor bolts to elevations required for proper attachment to supported equipment.

5. Equipment Mounting: Install exterior freestanding controllers on precast concrete bases or as indicated on drawings.
   a. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   b. Install anchor bolts to elevations required for proper attachment to supported equipment.

6. Install control cable in same trench as irrigation piping and at least 2 inches (51 mm) below or beside piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

J. Automatic Controller Accessory and/or Sensor Assembly Installation:
   1. Install all accessories per Manufacturer’s written recommendations.

3.04 FLUSHING, TESTING, AND ADJUSTMENT
A. After piping is installed and before sprinkler heads are installed, open control valves and flush out the system with full head of water.
B. Perform system testing upon completion of each section. Make necessary repairs and retest repaired sections as required.
C. Adjust sprinklers after installation for proper and adequate distribution of the water over the coverage pattern. Adjust for the proper arc of coverage.
D. Tighten nozzles on spray type sprinklers after installation. Adjust sprinkler adjusting screw on lateral line or circuit as required for proper radius. Interchange nozzles patterns if so directed by the Landscape Architect, to give best arc of coverage.
E. Adjust all electric remote control valves, pressure regulators and flow control stems for system balance and optimum performance.
F. Test and demonstrate the controller by operating appropriate day, hour, and station selection features as required to automatically start and shut down irrigation cycles. Demonstrate that system meets coverage requirements which are based on operation of one circuit at a time.
G. Upon completion of seeding/sodding by others and repair to seeded/sodded areas, carefully adjust lawn sprinkler heads so they will be flush with or not more than 1/2" above finish grade.

3.05 SERVICE
A. Engage factory-authorized service representatives to perform services during the installation and warranty periods.
B. When requested, or as required, return to the site during the subsequent fall season and winterize the system. Drain all water from the system or blow out the system with compressed air.
C. When requested, or as required, return to the site during the subsequent spring season and demonstrate to the Owner the proper procedures for the system start-up, operation, and maintenance. Repair damage to irrigation system that occurred during the winter due to improper installation.

3.06 DISPOSAL OF WASTE MATERIAL
A. Stockpile, haul from site, and legally dispose of waste materials, including unsuitable excavated materials, rock, trash, and debris.
B. Maintain disposal route clear, clean, and free of debris.

3.07 TEST REPORT RECORD

A. Tests of all water lines shall be recorded on a form with the data and format as listed below. When the form(s) is (are) completed, it (they) shall be turned over to the Owner.

B. Job Name: ____________________________________________

C. Test Location: __________________________________________

D. Type System: Landscape Irrigation

E. Test Pressure: __________________________________________

F. Length of Time for Test: _________________________________

G. I certify that the above test was performed in my presence and that all leaks observed were fixed prior to backfilling.

H. SIGNED: ____________________________________________

General Contractor's Superintendent

I. SIGNED: ____________________________________________

Irrigation Contractor's Superintendent

3.08 INSPECTION AND ACCEPTANCE

A. Upon completion of work, notify Landscape Architect in writing at least ten (10) days prior to requested date of inspection for acceptance. Submit written operating and maintenance instructions with request for inspection. Where inspected irrigation work does not comply with requirements, replace rejected work as specified until re-inspected by Landscape Architect and found to be acceptable. Remove rejected materials promptly from project site.

B. Test and demonstrate to the Landscape Architect and Owner the satisfactory operation of the system free of leaks.

C. Instruct the Owner's designated personnel in the operation of the system, including adjustment of controller and valves.

D. Upon acceptance the Owner will assume operation of the system.

3.09 WARRANTY

A. Warrant all components of underground and interior irrigation systems for a period of one year after the date of Substantial Completion. Replace in accordance with the drawings and specifications, any defective material or damage to the system which is the result of improper installation procedures, at no additional cost to the owner.

3.10 CLEANING

A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, soil, debris, and equipment. Repair damage resulting from irrigation system installation.

END OF SECTION 32.84.00
PART 1 - GENERAL

1.01 SUMMARY

A. SECTION INCLUDES:
   1. Substrate Preparation.
   2. Topsoil.
   3. Compost
   4. Placing Topsoil/Compost

1.02 RELATED REQUIREMENTS

A. Earthwork: Section 31.22.00.
B. Landscape Irrigation System: Section 32.84.00
C. Seeding: Section 32.92.19
D. Sodding: Section 32.92.23
E. Trees, Shrubs & Groundcovers: 32.93.00

1.03 SUBMITTALS

A. Soil Test Reports - Provide and pay for materials testing. Testing agency shall be acceptable to the Landscape Architect. Provide documentation that includes the following data:

B. Topsoil:
   1. Water pH factor.
   2. Mechanical analysis.
   3. Percentage of organic content.
   5. Soluble salt concentration.
   6. Recommendations on type and quantity of additives required to establish satisfactory pH factor and supply of nutrients to satisfactory level for planting.

C. Compost:
   1. The feedstock by percentage in the final compost product.
   2. A statement that the compost meets federal and state health and safety regulations.
   3. A statement that the composting process has met time and temperature requirements.
   4. A copy of the lab analysis verifying that the compost meets the requirements of Table 1.

D. Topsoil Sample
E. Submit one cubic foot of topsoil proposed for use. If topsoil source changes, submit sample from new source.
F. Compost Sample
G. Submit one cubic foot of compost proposed for use. If compost source changes, submit sample from new source.

PART 2 - PRODUCTS
2.01 SOIL MATERIALS

A. Topsoil:
1. Natural friable, fertile, fine loamy soil possessing the characteristics of representative topsoils in the vicinity which are capable of sustaining vigorous plant growth.
2. Free from subsoil, plants, weeds, litter, sods, stiff clay, stones larger than one (1”) inch in diameter, gravel, stumps, roots, toxic substances, or any other material which may be harmful to plant growth or hinder planting operations.
3. A minimum PH of 6.5
4. Obtained from naturally well drained areas which have never been stripped before.
5. Topsoil shall not be delivered in a frozen or muddy condition.

B. Compost:
1. Furnish compost that has been produced by aerobic (biological) decomposition of organic matter and meets requirements of Table 1.
2. Compost feedstocks may include, but are not limited to, leaves and yard trimmings, food scraps, food processing residuals, treated biosolids, manure and other agricultural residuals, forest residues, bark, and paper.
3. Ensure compost and/or wood chips do not contain any visible refuse, other physical contaminants, or any substance considered harmful to plant growth.
4. Do not use materials that have been treated with chemical preservatives as a compost feedstock or as wood chips.
5. Provide compost meeting all applicable EPA 40 CFR 503 standards for Class A biosolids including the time and temperature standards.
6. Provide a designated project stockpile of unblended compost for sampling and testing at the producer’s site.
7. Maintain compost in designated stockpiles at the producer’s site until accepted by the Landscape Architect.
8. The Landscape Architect reserves the right to sample compost at the jobsite.

Table 1

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle Size</td>
<td>Aggregate Size Classification Sieving</td>
<td>95% passing 5/8 inch</td>
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<tr>
<td></td>
<td></td>
<td>70% passing 3/8 inch</td>
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<tr>
<td>Heavy Metals Content</td>
<td>Tennessee Compost Regulations for Classification 1200-1-7-.11 (4) (c) for As (Arsenic), Cd (Cadmium), Cr (Chromium), Co (Cobalt), Cu (Copper), Pb (Lead), Hg (Mercury), Mo (Molybdenum), Ni (Nickel), Se (Selenium), Zn (Zinc)</td>
<td>Pass</td>
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<tr>
<td>Soluble Salts</td>
<td>Slurry Method, Mass basis</td>
<td>5.0 dS/m maximum*</td>
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<tr>
<td>pH</td>
<td>Slurry pH</td>
<td>5.5-8.5</td>
</tr>
<tr>
<td>Test</td>
<td>Method</td>
<td>Specification</td>
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<tr>
<td>---------------------</td>
<td>---------------------------------------------</td>
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<tr>
<td>Maturity</td>
<td>Germination and Root Elongation</td>
<td>&gt;80%</td>
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<tr>
<td>Organic Matter</td>
<td>Loss on Ignition Organic Matter Method</td>
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<tr>
<td>Stability</td>
<td>Carbon Dioxide Evolution Rate</td>
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</tr>
<tr>
<td>Fecal Coliform</td>
<td>Most Probable Number</td>
<td>1000 or less per gram</td>
</tr>
</tbody>
</table>

*A soluble salt content up to 10.0 dS/m for compost used in compost-manufactured soil will be acceptable.*

**PART 3 - EXECUTION**

### 3.01 EXAMINATION

A. Verify building and trench backfilling has been completed.

B. Verify substrate base has been contoured and compacted to the approximate depths required for the work.

C. Beginning landscape grading means existing conditions are acceptable.

### 3.02 SUBSTRATE PREPARATION

A. Prepare substrate to eliminate uneven areas and low spots. Maintain lines, levels, profile, and contours. Make changes in grade gradual. Blend slopes into level areas.

B. Remove debris, roots, branches, stones, in excess of 1 inch in size. Remove subsoil contaminated with petroleum products.

C. Scarify subgrade to depth of 3 inches where topsoil or compost is to be placed. Repeat scarifying in areas where equipment, used for hauling and spreading topsoil/compost, has compacted subsoil.

### 3.03 PLACING TOPSOIL/COMPOST

A. Place topsoil in landscaped beds (areas of groundcover and/or shrubs) shown on Drawings to a nominal 8-inch depth.

B. Place topsoil beneath sodded areas shown on Drawings to a nominal 3-inch depth.

C. Place topsoil on seeded areas shown on Drawings (or referenced as ‘Areas disturbed during construction to be seeded) to a nominal 4-inch depth.

D. Place topsoil/compost during dry weather and on dry, unfrozen subgrade.

E. Fine grade topsoil/compost eliminating rough or low areas. Maintain profiles and contours of subgrade.

F. Remove roots, weeds, rocks, and foreign material while spreading.

G. Manually spread topsoil/compost close to buildings, sidewalks, and curbs to prevent damage.

H. Lightly compact placed topsoil/compost.

I. Remove surplus subsoil and topsoil from site.
J. Leave stockpile area and site clean and raked, ready to receive seeding.

3.04 TOLERANCES
A. Top of Subsoil: Plus or minus 1 inch.
B. Top of Topsoil/Compost: Plus or minus 1/2 inch.

3.05 PROTECTION
A. Protect landscape grading and other features remaining as final work.
B. Protect existing structures, sidewalks, utilities, paving, and curbs.

END OF SECTION 32.91.19
SEEDING

SECTION 32.92.19

SEEDING

PART 1 - GENERAL

1.01 SUMMARY
A. Provide seeded areas as shown and specified. The work includes:
   2. Seeding lawns and other indicated areas.
   3. Mulching.

1.02 RELATED REQUIREMENTS:
1. Section 32.84.00: Landscape Irrigation System
2. Section 32.91.19: Landscape Grading
3. Section 32.92.23: Sodding
4. Section 32.93.00: Trees, Shrubs and Ground Covers

1.03 QUALITY ASSURANCE
A. Testing agency shall be acceptable to the Architect. Provide the following data:
   1. Test representative material samples proposed for use.
   2. Test soil material samples proposed for use in accordance with Section 32.91.19 - Landscape Grading:

B. Conduct a meeting at least thirty (30) days prior to start of fine grading work to review detailed requirements for compost spreading, fine grading, seeding, geotextile installation, irrigation and planting. Review status of submittals, samples and availability of materials. Establish and/or confirm work schedule. Establish procedures for coordinating work of related trade contractors for compost spreading, fine grading, irrigation installation, seeding, geotextile installation and planting. Request that representatives of each entity directly concerned with the above mentioned trades attend meeting including, but not limited to, the following:
   1. Contractor’s superintendent
   2. Earthwork trade contractor
   3. Topsoil supplier
   4. Seeding trade contractor
   5. Geotextile trade contractor
   6. Compost supplier
   7. Irrigation trade contractor
   8. Planting trade contractor
   9. Landscape Architect and Consultants
   10. Owner’s Representative

1.04 SUBMITTALS
A. Submit seed vendor's certification for required grass seed mixture, indicating percentage by weight, and percentages of purity, germination, and weed seed for each grass species.

B. Submit the following material samples:
   1. Seed
   2. Hydromulch

C. Submit the following material certification:
1. Fertilizer analysis.
2. Tackifier
3. Asphaltic emulsion
D. Submit materials test report.
E. Upon seeding, submit written maintenance instruction recommending procedures for maintenance of seeded areas.

1.05 DELIVERY, STORAGE AND HANDLING
A. Deliver seed and fertilizer materials in original unopened containers, showing weight, analysis, and name of manufacturer. Store in a manner to prevent wetting and deterioration.

1.06 PROJECT CONDITIONS
A. Work notification:
B. Notify Architect at least 7 working days prior to start of seeding operations.
C. Protect existing utilities, paving and other facilities from damage caused by seeding operations.
D. Perform seeding work only after planting and other work affecting ground surface has been completed.
E. Restrict traffic from seeded areas until seed is established. Erect signs and barriers as required.
F. Provide hose and watering equipment as required.
G. Furnishing and placement of topsoil shall be limited to locations shown on the drawings and shall be by earthwork contractor and is not a part of the seeding work.
H. Irrigation System: The irrigation system will be installed prior to seeding. Coordinate all work with irrigation subcontractor as required. Locate, protect, and maintain the irrigation system during seeding operation.

1.07 WARRANTY
A. Warrant all seeding for a period of one year after the date of acceptance against defects including death and unsatisfactory growth in the opinion of the Landscape Architect.
B. Replace in accordance with the drawings and specifications, all seeding that is dead or, as determined by the Landscape Architect, is in an unhealthy or unsightly condition. The cost of such replacement or repair is at Contractor's expense. Warrant all replacement seeding for 1 year after installation.
C. Warranty shall not include damage or loss of seeding caused by fires, floods, freezing rains, lighting storms, or winds over 75 miles per hour, winter kill caused by extreme, cold and severe winter conditions not typical of planting area; acts of vandalism or negligence on the part of the Owner.
D. Replacements:
   1. Replacements are subject to all requirements stated in this specification and subject to inspection by the Landscape Architect.
E. Repair grades, lawn areas, paving and any other damage resulting from replacement seeding operations, at no additional cost to the Owner.
F. Inspect job site monthly during warranty period to determine what changes, if any, should be made in the maintenance program. Submit all recommended changes in writing to the Landscape Architect and the Owner. In the absence of monthly written reports from the Contractor it shall be assumed that the Contractor is satisfied with the Owner's maintenance operations and procedures and waives any and all claims for damages against the Owner with respect to the warranty requirements of this specification.
G. At the close of warranty period, one year after acceptance of the work, notify the Owner and Landscape Architect in writing of the date for warranty inspection. Make any repairs or replacements identified by the Landscape Architect in the Warranty Inspection.
PART 2 - PRODUCTS

2.01 MATERIALS

A. Seeds shall meet the requirements of applicable seed laws and shall be tested in accordance with the most current edition of the U.S. Department of Agriculture Handbook No. 30, *Testing Agricultural and Vegetable Seed*. Seeds shall be from the last preceding crop and comply with the requirements outlined below for purity and germination. Each variety of seed shall be furnished in separate, strong bags with each bag being fully tagged or labeled to show the variety, weight, purity, germination, and test data prescribed by law. All test results shall be fully certified by the vendor or by a recognized seed testing agency. Seeds found not to comply with specification requirements shall be subject to rejection.

B. When mixing or forming seed mixture, the seeds shall be carefully and uniformly mixed. Seeds shall not be mixed until each variety of seed to be used in the mix has been inspected and/or tested separately and approved.

<table>
<thead>
<tr>
<th>Seed Varieties</th>
<th>Purity Minimum %</th>
<th>Germination Minimum %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kentucky Bluegrass (variety to be determined) <em>Poa pratensis</em></td>
<td>95</td>
<td>90</td>
</tr>
<tr>
<td>Jasper II Creeping Red Fescue <em>Festuca rubra</em> ‘Jasper II’</td>
<td>95</td>
<td>90</td>
</tr>
<tr>
<td>Padre Fescue <em>Festuca arundinacea</em> ‘Padre’</td>
<td>95</td>
<td>85</td>
</tr>
<tr>
<td>Biltmore Fescue <em>Festuca arundinacea</em> ‘Biltmore’</td>
<td>95</td>
<td>85</td>
</tr>
<tr>
<td>Stetson Fescue <em>Festuca arundinacea</em> ‘Stetson’</td>
<td>95</td>
<td>85</td>
</tr>
</tbody>
</table>

C. Seeding materials shall be free from seeds or bulbets of Wild Onion (*Allium vineal*), Canada Thistle (*Cirsium arvense*), and Johnson Grass (*Sorghum halepense*).

D. Seed species shall not contain more than six seeds per ounce of the seed of any of the following noxious weeds or the seeds of any other weed specifically listed as noxious including Bindweed (*Convolvulus arvensis*), Oxyedaisy (*Chrysanthemum leucanthemum*), Buckhorn (*Plantago lanceolata*), Corncockle (*Agrostemma githago*), Quackgrass (*Agropyron repens*), Dodder (*Cuscuta species*), Sorrel (*Rumex acetosella*).

E. Seed species shall not contain an excess of 2 percent by weight of weed seeds, noxious or otherwise.

F. Seed Mixtures, Rates and Seasons: Seeding mixtures, rates, and seasons shall be those specified herein. The types to be used for each area are specified by the drawings. Seeding shall be planted during the season and between the dates specified. Temporary cover shall be planted when it is required during seasons not suitable for planting the seed specified by the drawings.

1. Lawn (LWN): Spring or fall seeding.
   a. Dates: Plant between March 15 and May 1 or between August 15 and October 15.
   b. Seed Mix:
      1) 33.3% Biltmore Fescue, 33.3% Stetson Fescue and 33.3% Padre Fescue blend at 6 lbs. per 1000 sq. ft.
2. Turf Mix I: 3:1 or steeper Slopes.
   b. Seed Mix:
      1) 33.3% Biltmore Fescue, 33.3% Stetson Fescue and 33.3% Padre Fescue blend at 3 lbs. per 1,000 sq. ft.
      2) Kentucky Bluegrass at 2 lbs. per 1,000 sq. ft.
      3) Jasper II Creeping Red Fescue at 2 lbs. per 1,000 sq. ft.

3. Temporary Winter Seeding.
   a. Dates: Plant between October 15 and March 15.
   b. Seed Mix:
      1) Annual Ryegrass 2 lbs. per 1000 sq. ft.
      2) White Clover 0.50 lb. per 1000 sq. ft.

4. Temporary Summer Seeding.
   a. Dates: Plant between May 1 and August 15.
   b. Seed Mix:
      1) Red Clover 1 lb. per 1000 sq. ft.
      2) Weeping Lovegrass 0.50 lb. per 1000 sq. ft.

G. Compost – Seeded areas shall receive a minimum of compost as indicated on the drawings and as specified in section 32.19.19- Landscape Grading.

H. Fertilizers - Fertilizers shall be those readily available commercially. The application of fertilizer shall be at a rate of 200 pounds Ureaform (38-0-0) per acre with either 400 pounds of 15-15-15 per acre of 600 pounds of 6-12-12. Fertilizer rates shall be modified by the recommendations of the soil test and shall be approved by the Architect in writing.

I. Limestone - Limestone shall contain no less than 85 percent calcium carbonate by weight. It shall be crushed so that at least 85 percent will pass a no. 10 sieve. The application of limestone shall be at the rate of 2 tons per acre. Hydrated lime may be substituted at a rate of 1 ton per acre. Limestone rates shall be modified by the recommendations of the soil test and shall be approved by the Architect in writing.

J. Straw Mulch - Clean oat or wheat straw well seasoned before bailing, free from mature seed bearing stalks or roots of prohibited or noxious weeds. Use straw on slopes no steeper than 4:1 unless a tackifier/binder is applied. Omit straw if hydromulching procedure is used.

K. Wood cellulose fiber mulch - Degradable green dyed wood cellulose fiber of 100% recycled long fiber pulp, free from weeds or other foreign matter toxic to seed germination and suitable for hydromulching. Use for hydromulching in lieu of straw on erosion prone slopes greater than 4:1 or drainage swales.

1. Available manufacturers and types:
   c. Superior Turf Fiber: Cellin Mfg. Inc., Lorton, VA

L. Tackifier - Liquid concentrate diluted with water forming a transparent 3–dimensional film like crust permeable to water and air and containing no agents toxic to seed germination. Use tackifier on erosion prone slopes to hold either wood cellulose fiber mulch or straw.

1. Available Manufacturers and types:
   a. Polybind DLR: Celtite, Inc., Cleveland, OH
   b. Curasol AK: American Hoechst Corp., Elk Grove, IL
M. Water - Free of substances harmful to seed growth. Hoses or other methods of transportation shall be furnished by the Contractor.

N. Geotextiles: As specified in Section 32.05.19.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine finish surfaces, grades, compost quality, and depth. Do not start seeding work until unsatisfactory conditions are corrected and acceptable for seeding.

3.02 PREPARATION

A. Limit preparation to areas which will be immediately seeded.

B. Loosen soil and topsoil of seeded areas to minimum depth of 4". Remove stones over 1" in any dimension and sticks, roots, rubbish and extraneous matter. It is strongly recommended that scarifying and preparation of seedbeds on cut and fill slopes be accomplished with tools or equipment specially designed for this purpose. Small furrows or grooves formed in the slopes shall be horizontal or as nearly horizontal as practical. The work shall be performed only when the ground is in a workable and tillable condition as determined by good farming practices.

C. Grade seeded areas to a smooth, free drainage even surface with a loose, moderately coarse texture. Roll and rake, remove ridges, and fill depressions as required to drain.

D. Apply compost at depth determined on the drawings.

E. Apply limestone, at rate determined by the soil test, to adjust pH of topsoil. Distribute evenly by machine and incorporate thoroughly into topsoil.

F. Apply fertilizer to all seeded areas at the approved rates as determined by the soil test.

G. Apply fertilizers by mechanical rotary to drop type distributor, thoroughly and evenly incorporated with soil to a depth of 3" by discing or other approved method. Fertilize areas inaccessible to power equipment with hand tools and incorporate into soil.

H. Restore prepared areas to specified condition if eroded, settled, or otherwise disturbed after fine grading and prior to seeding.

3.03 INSTALLATION

A. Seeding:

1. Seed immediately after preparation of bed. See 2.01 F - Seed Mixtures, Rates and Seasons.

2. Seed all areas within and adjoining project limits disturbed as a result of construction operations.

3. Perform seeding operations when the soil is dry and when winds do not exceed 5 miles per hour velocity.

4. Apply seed with a rotary or drop type distributor. Installed seed evenly by sowing equal quantities in 2 directions, at right angles to each other.

B. Hydromulching:

1. Hydromulching is acceptable in areas of greater than 4:1 slopes.

2. Use a hydromulcher (sprayer) and apply mixtures at the following rates. Mix in accordance with manufacturer's recommendations.

3. Apply hydromulch slurry to indicated areas.

a. Tackifier: 60 gals/acre.

b. Wood cellulose fiber mulch:

   1) 2,000 lbs./acre on slopes greater than 4:1.

   2) 1,500 lbs./acre on slopes less than 4:1.
C. Mulching:
1. Place straw mulch on seeded areas within 24 hours after seeding. Omit straw mulch if hydroseeding procedure is used.
2. Place straw mulch uniformly in a continuous blanket at the rate of 2-1/2 tons per acre, or two 50 lb. bales per 1,000 sq. ft. of area. A mechanical blower may be used for straw mulch application when acceptable to the Architect.
3. Anchor straw mulch with liquid tackifier applied uniformly at a rate of 60 gal. per acre on slopes greater than 4:1.
4. Protect structures, walls, paving, plantings, and all nonseeded areas from liquid tackifier over-spray.

D. Geotextiles:
1. Place geotextile on seeded areas the same day of seeding.
2. Place geotextile with minimum lap recommended by the manufacturer for the specific type of installation.
3. Place geotextile in direct contact with surface of soil.
4. Anchor geotextile with pins or staples in accordance with Section 32.05.19.
5. Anchor toe and top of geotextile installation with manufacturer’s recommendations for the specific type of installation.

E. Provide straw bale checking at intervals as shown on the drawings and as required to adequately slow water velocity and impede soil loss

3.04 MAINTENANCE
A. Maintain seeded areas until completion and acceptance of the entire project or not less than 30 days after completion and acceptance of seeding operations.
B. Maintain seeded areas, including watering, spot weeding, mowing, applications of herbicides, fungicides, insecticides, and re-seeding until a full, uniform stand of grass free of weeds, undesirable grass species, disease, and insects is achieved and accepted by the Architect.
1. Water periodically to maintain adequate surface soil moisture for proper seed germination. Continue watering for not less than 30 days. Thereafter apply water as required until provisional acceptance.
2. Repair, rework, and re-seed all areas that have washed out, are eroded, or do not catch.
3. Mow lawn (LWN) and Turf Mix I areas as soon as lawn top growth reaches a 4" height. Cut back to 3" in height. Repeat mowing as required to maintain specified height. Following mowing limit as directed by the Architect.

3.05 CLEAN UP AND PROTECTION:
A. During seeding work, keep pavements clean and work area in an orderly condition.
B. Upon completion of work, clear grounds of debris, superfluous materials and all equipment. Remove from site to satisfaction of the Architect.
C. Protect seeding work and materials from damage due to landscape operations, operations by other contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged seeding as directed, at no additional cost to the Owner.

3.06 INSPECTION AND ACCEPTANCE
A. Upon completion of work, notify the Architect at least ten (10) days prior to requested date of inspection for acceptance. Where inspected work does not comply with requirements, replace rejected work and continue specified maintenance until re-inspected by the Architect and found to be acceptable.
1. Seeded areas will be acceptable provided all requirements, including maintenance, have been complied with, and a healthy, uniform, close stand of the specified mixture is established free of weeds, undesirable species, disease, and insects.

2. No individual seeded areas shall have bare spots or unacceptable cover totaling more than 2% of the individual areas, in areas requested to be inspected.

B. Upon satisfactory completion of repairs and, or replacements, the Architect certifies, in writing, the acceptance of the work in total.

END OF SECTION 32.92.19
PART 1 - GENERAL

1.01 DESCRIPTION
   A. Provide sodded lawns as shown and specified. The work includes:
      2. Sodding lawns and other indicated areas.
      3. Maintenance

1.02 RELATED REQUIREMENTS:
   A. Landscape Irrigation System: Section 32.84.00
   B. Landscape Grading: Section 32.91.19
   C. Seeding: Section 32.92.19
   D. Trees, Shrubs and Ground Covers: Section 32.93.00

1.03 QUALITY ASSURANCE
   A. Sod: Comply with American Sod Producers Association (ASPA) classes of sod materials.
   B. Provide and pay for materials testing. Testing agency shall be acceptable to the Landscape Architect. Provide the following data:
      1. Test representative materials samples proposed for use.
         a. Topsoil:
            1) Water pH factor.
            2) Mechanical analysis.
            3) Percentage of organic content.
            4) Soil test ratings for Phosphorus, Potassium, Calcium, Magnesium, Zinc, Iron, and Manganese.
            5) Soluble salt concentration.
            6) Recommendations on type and quantity of additives required to establish satisfactory pH factor and supply of nutrients to bring nutrients to satisfactory level for planting.

1.04 SUBMITTALS
   A. Submit sod growers certification of grass species. Identify source location.
   B. Submit the following materials certification:
      1. Fertilizer analysis.
      2. Limestone analysis.
   C. Submit topsoil test report.
   D. Upon sodded lawn acceptance, submit written maintenance instructions recommending procedures for maintenance of sodded lawns.

1.05 DELIVERY, STORAGE AND HANDLING
   A. Cut, deliver, and install sod within 24-hour period.
   B. Do not harvest or transport sod when moisture content may adversely affect sod survival.
   C. Protect sod from sun, wind and dehydration prior to installation.
   D. Do not tear, stretch or drop sod during handling and installation.
1.06 PROJECT CONDITIONS
   A. Work notification: Notify Landscape Architect at least 7 working days prior to start of sodding operations.
   B. Protect existing utilities, paving, and other facilities from damage caused by sodding operations.
   C. Perform sodding work only after planting and other work affecting ground surface has been completed.
   D. Restrict traffic from lawn areas until grass is established. Erect signs and barriers as required.
   E. Provide hose and lawn watering equipment as required.
   F. The irrigation system will be installed prior to sodding. Coordinate all work with irrigation contractor as required. Locate, protect and maintain the irrigation system during sodding operations. Repair irrigation system components damaged during sodding operations.

1.07 WARRANTY
   A. Warrant all sodding for a period of one year after the date of acceptance against defects including death and unsatisfactory growth in the opinion of the Landscape Architect.
   B. Replace in accordance with the drawings and specifications, all sod that is dead or, as determined by the Landscape Architect, is in an unhealthy or unsightly condition. The cost of such replacement (s) is at Contractor's expense. Warrant all replacement sod for 1 year after installation.
   C. Warranty shall not include damage or loss of sodding caused by fires, floods, freezing rains, lightning storms, or winds over 75 miles per hour, winter kill caused by extreme, cold and severe winter conditions not typical of planting area; acts of vandalism or negligence on the part of the Owner.
   D. Replacements:
      1. Replacements are subject to all requirements stated in this specification and subject to inspection by the Landscape Architect.
   E. Repair grades, lawn areas, paving and any other damage resulting from replacement sodding operations, at no additional cost to the Owner.
   F. Inspect job site monthly during warranty period to determine what changes, if any, should be made in the maintenance program. Submit all recommended changes in writing to the Landscape Architect and the Owner.
   G. At the close of warranty period, one year after acceptance of the work, notify the Owner and Landscape Architect in writing of the date for warranty inspection.
   H. Make any repairs or replacements identified by the Landscape Architect in the Warranty Inspection.

PART 2 - PRODUCTS
2.01 MATERIALS
   A. Sod:
      1. Sod shall be nursery grown sod composed of a blend of turf-type fescues plus 5% Kentucky Bluegrass.
      2. Sod containing Common Bermudagrass, Quackgrass, Johnsongrass, Poison Ivy, Nutsedge, Nimblewill, Canada Thistle, Timothy, Bentgrass, Wild Garlic, Ground Ivy, perennial Sorrel, or Bromegrass weeds will not be acceptable.
      3. Provide sod free of grassy or broadleaf weeds.
      4. Provide well-rooted, healthy sod, free of diseases, nematodes and soil borne insects. Provide sod uniform in color, leaf texture, density, and free of weeds, undesirable
grasses, stones, roots, thatch, and extraneous material; viable and capable of growth and development when planted.

5. Furnish sod machine stripped in square pads or strips not more than 3'-0" long; uniformly 1" to 1-1/2" thick with clean cut edges. Mow sod before stripping.

B. Fertilizer - Fertilizers shall be those readily available commercially. The application of fertilizer shall be at a rate of 200 pounds Ureaform (38-0-0) per acre with either 400 pounds of 15-15-15 per acre or 600 pounds of 6-12-12. Fertilizer rates shall be modified by the recommendation of the soil test and shall be approved by the Landscape Architect in writing.

C. Limestone - Limestone shall contain no less than 85 percent calcium carbonate by weight. It shall be crushed so that at least 85 percent will pass an no. 10 sieve.
   1. The application of limestone shall be at the rate of 2 tons per acre.
   2. Hydrated lime may be substituted at a rate of 1 ton per acre.
   3. Limestone rates shall be modified by the recommendations of the soil test and shall be approved by the Landscape Architect in writing.

D. Stakes - Use where sod slopes greater than 3:1 or in drainage swales.
   1. Softwood, 3/4" dia. x 8" long or,
   2. Steel, tee shaped pins, 4" head x 8" leg.

E. Water:
   1. Free of substance harmful to sod growth.
   2. Hoses or other methods of transportation furnished by Contractor.

PART 3 - EXECUTION

3.01 INSPECTION
   A. Examine finish surfaces, grades, topsoil quality and depth. Do not start sodding work until unsatisfactory conditions are corrected.

3.02 PREPARATION
   A. Limit preparation to areas which will be immediately sodded.
   B. Loosen topsoil of lawn areas to minimum depth of 4". Remove stones over 1" in any dimension and sticks, roots, rubbish and extraneous matter.
   C. Grade lawn areas to smooth, free draining and even surface with a loose, uniformly fine texture. Roll and rake; remove ridges and fill depressions as required to drain.
   D. Apply limestone at rate determined by the soil test, to adjust pH of topsoil. Distribute evenly by machine and incorporate thoroughly into topsoil.
   E. Apply fertilizer at the approved rates. Apply fertilizer by mechanical rotary or drop type distributor, thoroughly and evenly incorporated with the soil to a depth of 3" by discing or other approved methods. Fertilize areas inaccessible to power equipment with hand tools and incorporate it into soil.
   F. Dampen dry soil prior to sodding.
   G. Restore prepared areas to specified condition if eroded, settled, or otherwise disturbed after final grading and prior to sodding.

3.03 INSTALLATION
   A. Sodding:
      1. Lay sod to form a solid mass with tightly-fitted joints. Butt ends and sides of sod strips. Do not overlay edges. Stagger strips to offset joints in adjacent courses. Remove excess sod to avoid smothering of adjacent grass.
2. Provide sod pad top flush with adjacent curbs, sidewalks, drains, and seeded areas.
3. Do not lay dormant sod or install sod on saturated or frozen soil.
4. Install initial row off sod in a straight line, beginning at bottom of slopes, perpendicular to direction of the sloped area. Place subsequent rows parallel to and lightly against previously installed row.
5. Peg sod on slopes greater than 3 to 1 to prevent slippage at a minimum rate of 2 stakes per yd. of sod but no less than 2 stakes per individual piece of sod.
6. Water sod thoroughly with a fine spray immediately after laying.
7. Roll with light lawn roller to ensure contact with sub-grade.

### 3.04 MAINTENANCE

A. Maintain sodded lawns until completion and acceptance of the entire project or not less than 30 days after completion and acceptance of sodding operations.
B. Maintain sodded lawn areas, including water, spot weeding, mowing, application of herbicides, fungicides, insecticides and resodding until a full, uniform stand of grass free of weed, undesirable grass species, disease, and insects is achieved and accepted by the Landscape Architect.
C. Water sod thoroughly every 2 to 3 days, as required to establish proper rooting.
D. Repair, rework and resod all areas that have washed out or are eroded.
E. Replace undesirable or dead areas with new sod.
F. Mow lawn areas as soon as lawn top growth reaches a 4” height. Cut back to 3” height. Repeat mowing as required to maintain specified height.
G. Not more than 40% of grass leaf shall be removed at any single mowing.
H. Apply herbicides as required to control weed growth or undesirable grass species.
I. Apply fungicides and insecticides as required to control diseases and insects.
J. Remove sod pegs.

### 3.05 CLEAN UP AND PROTECTION

A. During sodding work, keep pavements clean and work area in an orderly condition.
B. Upon completion of work, clear grounds of debris, superfluous materials and all equipment. Remove from site to satisfaction of Landscape Architect.
C. Protect sodding work and materials from damage due to landscape operations, operations by other contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged sodding work as directed, at no additional cost to the Owner.

### 3.06 INSPECTION AND ACCEPTANCE

A. Upon completion of work, notify Landscape Architect at least ten (10) days prior to requested date of inspection for acceptance. Where inspected work does not comply with requirements, replace rejected work and continue specified maintenance until re-inspected by Landscape Architect and found to be acceptable. Sodded areas will be acceptable provided all requirements, including maintenance, have been complied with, and a healthy, even colored viable lawn is established, free of weeds, undesirable grass species, disease, and insects.
B. Upon satisfactory completion of repairs and/or replacements, the Landscape Architect certifies, in writing, the acceptance of the work in total.
C. The one-year warranty period begins on the date of the acceptance of the work in total.

END OF SECTION 32.92.23
PART 1 - GENERAL

1.01 SUMMARY
A. Provide and furnish all trees, shrubs and ground covers, labor, miscellaneous materials and equipment required or inferred from drawings and specifications to complete the work of this section.

1.02 RELATED REQUIREMENTS
A. Earthwork: Section 31.22.00
B. Landscape Irrigation System: Section 32.84.00
C. Landscape Grading: Section 32.91.19
D. Seeding: Section 32.92.19
E. Sodding: Section 32.92.23

1.03 QUALITY ASSURANCE
A. Installers Qualifications:
   1. The Contractor shall have a minimum of seven (7) years specialized experience in the installation of planting projects of comparable size and quality.
   2. The Contractor shall have completed one planting project whose contract sum was no less than the value of the planting work of this project within the last three (3) years.
   3. The firm shall be a contractor licensed by the State in which the project is located.
   4. The Contractor shall hold the specialty classifications on their contractor's license that relate to the work of this section in accordance with the requirements of authorities having jurisdiction.
   5. The Contractor's license shall have a monetary limit that is not exceeded by the value of the planting work of this project.
   6. The Contractor shall have a satisfactory record for installation and warranty performance on said projects. Workmanship shall be of the highest quality.
B. Applicable Standards:
   1. Plant names indicated comply with "Standardized Plant Names" as adopted by the latest edition of the American Joint Committee of Horticultural Nomenclature. Names of varieties not listed conform generally with names accepted by the nursery trade. Provide stock true to botanical name and legibly tagged.
   2. Provide stock true to botanical name and legibly tagged. Characteristics of individual plant species shall be as described in "Hortus Third". The character of individual plant varieties not listed shall be as defined in current horticultural literature and practice.
C. General: All plants shall be grown in a recognized nursery in accordance with good horticultural practice. Provide healthy stock free of disease, insects, eggs, larvae and defects such as knots, sun scald injuries abrasions or disfigurement.
D. Substitutions: Do not make substitutions. If specified plant material is not obtainable, submit to Landscape Architect proof of non-availability and proposal for use of equivalent material. For proof of non-availability submit a written statement from a minimum of 6 reliable nursery sources (American Nurserymen's Association Members) that the plant in question is not obtainable in the Eastern United States.

E. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.

F. Topsoil: Before delivery of topsoil, furnish Landscape Architect with written statement giving location of properties from which topsoil is to be obtained, depth to be stripped, and, if applicable, crops grown during past 2 years.

G. Soil Test Report: Contractor shall engage a reputable laboratory to include testing and analysis of soils representative of planting areas on site and new topsoil with reference to specified plant materials. The soil test report should provide the following data: Water pH; soil test ratings for Phosphorus, Potassium, Calcium, Magnesium, Zinc, Iron and Manganese; percentage of organic matter; soluble salts; recommendations on type and quantity of additives required to establish satisfactory pH factor and supply nutrients to bring nutrients to satisfactory level for planting specified plant materials.

H. Approval and Selection of Materials and Work: The selection of all materials and the execution of all operations required under the specifications and drawings is subject to the approval of the Landscape Architect. The Landscape Architect has the right to reject any and all materials and any and all work which, in the opinion of the Landscape Architect does not meet the requirements of the Contract Documents at any stage of the operations. The Contractor shall promptly remove rejected work and or materials from job site. The Contractor shall replace rejected work and or materials promptly.

1.04 SUBMITTALS

A. Unit Pricing:

1. Submit unit prices for each plant species specified on the drawings and for landscape materials including, but not limited to:
   a. Seeding
   b. Sod
   c. Topsoil
   d. Mulch
   e. Bed Edging
   f. Geosynthetics (if applicable)
   g. Root Barrier (if applicable)

2. Unit pricing may be denoted with both “add” and “deduct” units for materials which are time sensitive or which are non-refundable. The “add” units, however, must concur with the bid and/or approved proposal.

B. Certification:

1. Submit certificates of inspection for all plant materials with project close-out documents and as required by governmental authorities.
2. Submit manufacturer's or vendor's certified analysis for soil amendments and fertilizer materials. Submit other data substantiating that materials comply with specified requirements.

C. Notice of Sources: Within 15 days following the award of Contract, the Landscape Architect shall be notified in writing of the sources of all plant materials for this project. This notification shall include an itemized list of all plant materials and the complete address and telephone number of the supplier of each plant. Any requests for plant material substitution shall be included with this notification. Requests for substitution will not be considered before or after this notification.

D. Specimen Plant Material Photography:
   1. Contractor must locate, photograph or videotape from both sides with a scale figure, and tag at the source each individual plant material labeled "Specimen" in the Plant List.
   2. The Contractor must furnish photographs of each individual plant and inform Landscape Architect in writing of the source/location at least ten (10) days prior to digging.
   3. Subsequently the Landscape Architect may, at his discretion, inspect and seal specimen plant materials before digging. In the event plant material is found to be unacceptable, the Contractor will pursue other sources until acceptable plant material is found, at no additional cost to the owner.

E. The contractor will reimburse the owner for time and travel costs incurred by the Landscape Architect ($500.00 per day plus travel costs) because of requested inspections of unacceptable specimen plant materials.

F. Approval at the plant source does not impair the right of inspection and rejection during the progress of the work.

G. Planting Schedule: Submit planting schedule showing scheduled dates for each type of planting work in each area of site. Submit planting schedule prior to beginning of the work. Planting schedule shall demonstrate a thorough understanding of the overall project schedule in accordance with the requirements of this specification section and good horticultural practices of the area in which the project is located.

H. Maintenance Instructions: Upon completion of the installation, submit typewritten recommendations for maintenance of any portion of the landscape which, in the opinion of the Contractor, requires special attention.

I. Topsoil Sample: Submit one cubic foot of topsoil proposed for use, two (2) weeks prior to beginning work. If topsoil source changes submit sample from new source.

J. Soil Test Report: Submit results of laboratory soil tests two (2) weeks prior to beginning of the work. If topsoil source changes submit soil test report from new source.

K. Approval: Obtain approval from Landscape Architect in writing for all submittals including miscellaneous materials prior to beginning of work.

L. Miscellaneous Materials: Submit product literature and samples of all miscellaneous materials required to complete the work of this section.

M. Provide plant material record drawings:

N. Legibly mark drawings to record actual construction.
O. Identify field changes of dimension and detail and changes made by Change Order referenced to permanent surface improvements.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Deliver fertilizer materials in original, unopened, and undamaged containers showing weight, analysis, and name of manufacturer. Store in manner to prevent wetting and deterioration.

B. Shipment and Delivery:

1. Promptly notify the Landscape Architect in advance, when the plant material is to be delivered and the manner of shipment.
2. Furnish therewith an itemized list of the actual quantity and sizes.
3. Deliver the necessary inspection certificates to accompany each plant or shipment prior to acceptance and planting.
4. When shipment is made by truck, pack all plant material to provide adequate protection against climate and breakage during transit and tie to prevent whipping.
5. Cover the tops with tarpaulin to minimize wind whipping and drying, or spray adequately with anti-transparent.
6. Exercise care at all times during the handling operations to prevent damage to bark, branches, and root system.
7. Employ a suitable method of handling to insure the careful workmanlike delivery of heavy balled plants to preclude cracked plant balls. No balled plant shall be planted if the ball is cracked or broken either before or during the planting operation.

C. Protection After Delivery: The balls of "B & B" plants which cannot be planted immediately on delivery shall be covered with moist soil or mulch, or other protection from drying winds, sun, and freezing temperatures. Rooted plants shall be planted or heeled in immediately upon delivery. All plants shall be watered as necessary until planted.

D. Do not remove container-grown stock from containers until planting time.

E. Label at least one tree and one shrub of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.

F. Do not remove labels attached to plant material until directed by the Landscape Architect to do so.

1.06 PROJECT CONDITIONS

A. Work notification: Notify Landscape Architect at least 7 working days prior to installation of plant material.

B. Protect existing utilities, paving, and other facilities from damage caused by landscaping operations.

C. Proceed with and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required. Schedule delivery of plant materials to closely coincide with installation and to minimize stored plant materials. All stored plant materials shall be protected, maintained and subject to all provisions of this specification.

D. Existing Utilities: The Contractor shall--at his own expense--locate, excavate and verify the alignment and depth of all underground utilities as shown on the drawings. Perform work in a manner which will avoid possible damage. Maintain grade stakes set by others unless removal is
mutually agreed upon by parties concerned. All damage to utilities resulting from work covered in these specifications will be repaired at the Contractor's expense.

E. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, adverse soil conditions or obstructions, notify Landscape Architect in writing before planting.

F. Planting Time:

G. Plant or install materials during suitable weather conditions.

H. A dormant season planting is required.

I. Planting Schedule: Submit proposed planting schedule to Landscape Architect. Schedule dates for each type of landscape work during contract period.

J. Out-of-Season Planting: Out-of-Season planting shall not be permitted. If an out-of-season planting would otherwise be required in order to complete the work, submit in writing a proposed date during the dormant season for completing required planting or plant replacement work and obtain Landscape Architect's approval in writing.

1.07 WARRANTY

A. Warrant all trees, shrubs and ground covers against defects including death and unsatisfactory growth in the opinion of the Landscape Architect. Warrant trees shrubs and groundcovers for one (1) year from the date of Substantial Completion of the entire project.

B. Replace in accordance with the drawings and specifications, all plants that are dead or, as determined by the Landscape Architect, are in an unhealthy or unsightly condition, and have lost their natural shape due to dead branches, or other causes. The cost of such replacement(s) is at Contractor's expense. Warrant all replacement plants for one (1) year after installation.

C. Warranty shall not include damage or loss of trees, plants, or ground covers caused by fires, floods, freezing rains, lightning storms, or winds over 75 miles per hour, winter kill caused by extreme cold and severe winter conditions not typical of planting area; acts of vandalism or negligence on the part of the Owner.

D. Remove and immediately replace all plants, as determined by the Landscape Architect, to be unsatisfactory during the initial planting installation and one year warranty period.

E. Replacements: Match adjacent specimens of same species. Replacements are subject to all requirements stated in this specification and subject to inspection by the Landscape Architect.

F. Repair grades, paving and any other damage resulting from replacement planting operations, at no additional cost to the Owner.

G. Inspect job site monthly during warranty period to determine what changes, if any, should be made in the maintenance program. Submit all recommended changes in writing to the Landscape Architect and the Owner. In the absence of monthly written reports from the Contractor it shall be assumed that the Contractor is satisfied with the Owner's maintenance operations and procedures and waives any and all claims for damages against the Owner with respect to the warranty requirements of this specification.

H. At the close of the warranty period, one (1) year after Substantial Completion of Trees, Shrubs, and Groundcovers work, notify the Owner and Landscape Architect in writing of the date for
warranty inspection. Make any repairs or replacements identified by the Landscape Architect in the Warranty Inspection.

I. Upon satisfactory completion of repairs and/or replacements the Landscape Architect certifies, in writing, the final acceptance of the work.

PART 2 - PRODUCTS

2.01 TOPSOIL

A. New topsoil shall be fertile, friable, natural surface soil of fine to medium textured loamy character.

B. Topsoil should be representative of the dark brown surface soils in the vicinity which produce heavy growth.

C. The topsoil shall be reasonably free from subsoil, objectionable weeds, litter, sod, stiff clay, stones larger than one inch in any dimension, stumps, roots, weeds, toxic substances, or any other material which may be harmful to plant growth or hinder planting operations.

D. Topsoil shall exhibit the following characteristics as evidenced by the soil test report:

E. Water pH 6.5 minimum

F. Phosphorus 9-30 pounds per acre

G. Potassium 45-160 pounds per acre

H. Organic matter 2.5% minimum

I. Soluble salts 0-1060 parts per million.

J. Obtain topsoil only from naturally, well drained sites where topsoil occurs in a depth of not less than four inches.

K. Topsoil shall not be delivered in a frozen or muddy condition.

L. The furnishing of all topsoil needed for planting and soil mix will be considered a subsidiary portion of this specification and covered in the cost of trees, shrubs, and ground covers.

2.02 SOIL AMENDMENTS

A. Fertilizer shall be a mixed commercial fertilizer, of Grade 10-10-10 or as recommended by the Soil Report with guaranteed chemical analysis of contents marked on containers or sacks.

B. Lime:

C. Ground or pulverized of horticultural grade capable of neutralizing soil acidity and containing not less than 85% of total carbonates.

D. Containers or sacks shall be labeled to show chemical and mechanical analysis.

2.03 PLANTING SOIL MIX

A. Planting soil mix shall be provided amended as per soils test report recommendations.
Basic soil mix is as follows:

B. 100% Topsoil (as specified)

C. Fertilizer as recommended

D. Lime as recommended

2.04 PLANT MATERIALS

General:

A. A complete list of plants including a schedule of sizes, quantities, and other requirements is shown on the drawings. In the event that quantity discrepancies or material omissions occur in the plant materials list, the planting plans shall govern.

B. Specific requirements concerning plant material and the manner in which it is to be supplied are shown on the drawings and plant list.

C. Acclimatization: Plants must have grown under climatic conditions and temperature extremes similar to those of the locality of the project site for a minimum of two years immediately prior to being planted on the job.

D. Quality and Size:

E. Plants shall have a habit of growth that is normal for a well maintained sample of the species and shall be sound, healthy, vigorous and free from insect pests, plant diseases, and injuries. Plants to be selected for specific branching habit where a range of habit occurs within a species shall be furnished thickly branched as noted on the plant list. All plants shall equal or exceed the measurements specified in the plant list, which are minimum acceptable sizes. They shall be measured before pruning with branches in normal position. Pruning shall be done at the discretion of or as directed by the Landscape Architect, but in no case shall the plants supplied under this contract be pruned back to such an extent that they no longer meet specifications. Requirements of plants in the plant list generally follow the code of standards currently recommended by the American Association of Nurserymen, Inc., in the American Standard of Nursery Stock.

F. Collected Plant Material. (Plants which are not nursery grown). Plant material shall be collected only if specifically authorized in writing by the Landscape Architect. Any collected plant material which is authorized shall be dug with a ball of earth which has a diameter at least 1/3 greater than that specified for nursery-grown stock and burlapped.

G. Plants furnished shall be at least the minimum size indicated. Larger stock is acceptable, at no additional cost, and providing that the larger plants will not be cut back to size indicated. Provide plants indicated by two measurements so that only a maximum of 25% are of the minimum size indicated and 75% are of the maximum size indicated.

H. Specimen Plant Material: Plants labeled "Specimen" in the plant list shall be outstanding plants of the species and shall be of the highest quality possessing all the characteristics shown in the plant materials list.

I. Furnish plants to match as closely as possible whenever symmetry is called for.

J. Balled and Burlapped Plants: All plants designated "B &B" on the plant list shall have firm natural balls of soil in sizes as set forth in the "American Standard for Nursery Stock" and shall be:

a. Wrapped firmly with burlap or approved material.
b. Bound carefully with twine, cord or wire mesh, in a manner so as not to damage the bark, break branches, or destroy natural shape.

c. Covered with moist soil, mulch, or other protection from drying if not planted immediately. Cracked or mushroomed balls are not acceptable.

K. Bare Root Plants: Plants designated “BR” in the list of plants to be furnished shall be dug with substantially all of the root system intact, and with the earth carefully removed from the roots. Cover all roots with a thick coating of mud by puddling, or otherwise protect from drying after they are dug.

L. Container grown plants in cans or plastic containers will be acceptable in lieu of balled and burlapped plants provided that they are of specified quality. The container must be removed prior to planting, care being exercised as to not injure the plant.

M. Trees:

N. Provide trees of height and caliper listed or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed.

O. Determining dimensions for trees are caliper, height and spread. Caliper taken 6" above ground for trees up to and including 4" caliper. Trees over 4" caliper measure 12" above ground. Height and spread dimensions specified refer to the main body of the plant and not from branch tip to tip. Take measurements with branches in normal position.

P. Evergreen trees shall be branched to the ground unless noted otherwise on the drawings.

Q. No pruning wounds shall be present with a diameter of more than 1” and such wounds must show vigorous bark on all edges.

R. Shrubs:

S. The measurements for height shall be taken from the ground level to the average height of the top of the plant and not the longest branch.

T. Single stemmed or thin plants will not be accepted.

U. Side branches shall be generous, well-twigged, and the plant as a whole well-bushed to the ground.

V. Plants shall be in a moist, vigorous condition, free from dead wood, bruises, or other root or branch injuries.

W. Ground Cover:

X. Provide good ground cover plants established and well-rooted in removable containers or integral peat pots and with not less than minimum number and length of runners by ANSI Z60.1 for the pot size shown and as listed in plant list.

Y. Perennials:

Z. Provide perennial bulbs, corms and tubers which are fleshy and free of rot and not less than the grade and size recommended by ANSI Z60.1 for the size shown or listed.
AA. Provide good perennials in either a dormant condition or actively growing. Actively growing perennials shall be furnished rooted in removable containers or field dug. Field dug perennials shall be in a moist, vigorous condition with no sign of desiccation.

2.05 MISCELLANEOUS LANDSCAPE MATERIALS

A. Burlap for wrapping earthball to be biodegradable jute mesh not less than 7.2 oz. per square yard.

B. Stakes: screw-in steel anchors in various lengths from 15" to 48" capable of holding from 200 to 6000 pounds as distributed by A.M. Leonard Co. (1-800-543-8955) and Ben Meadows Co. (1-800-241-6401), 2 x 2 or better uniform grade pressure treated pine, or sound new hardwood or redwood free of knot holes and other defects.

C. Guy and Wire Ties: ArborTie tree staking tie or approved equivalent. Install in accordance with manufacturer’s recommendation. Three (3), equally spaced guys per tree.

D. Soil Separator: Rot resistant polypropylene filter fabric, water permeable, and unaffected by freeze-thaw.

E. Drainage Gravel: Clean 3/4" crushed stone.

F. Water transportation is the sole responsibility of the Contractor.

G. Mulch: 6 month old well rotted shredded native hardwood bark mulch not larger than 4" in length and 1/2" in width, free of woodchips and sawdust.

H. Anti-Desiccant: Protective film emulsion providing a protective film over plant surfaces; permeable to permit transpiration. Mixed and applied in accordance with manufacturer’s instructions.

I. Pre-Emergence Herbicide for general use shall be "Ronstar", "Casaron", or approved equal. Apply at the rates, times and manner recommended by the manufacturer.

J. Metal Bed Edging: Steel Bed Edging, 3/16" thick X 4" height with compatible Steel Stakes, 3/16" thick X 15" length, color: Black, as manufactured by Border Concepts, Inc., P.O. Box 471185, Charlotte, NC 28247, TEL: 704.541.5509, FAX: 704.541.5610, www.borderconcepts.com, or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

A. General

B. Contractor must examine conditions under which planting is to be installed. Review applicable architectural and engineering drawings, and be familiar with alignment of underground utilities before digging.

C. Planting Time: Planting operations are to be performed at such times of the year as the job may require, with the stipulation that the Contractor guarantees the plant material as specified herein. Plant only during periods when weather conditions are suitable.

D. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Landscape Architect's acceptance before start of excavation for planting work. Make adjustments as may be requested.
E. Notify Landscape Architect before planting in writing of adverse sub-surface drainage or soil conditions. State conditions and submit a proposal for correction including costs. Obtain approval for method of correction prior to continuing work in the affected area. In the event that alternate locations are selected, the Contractor will prepare such areas at no additional expense to the Owner.

F. Planting shall be performed only by experienced workmen familiar with planting procedures under the supervision of a qualified supervisor.

3.02 EXCAVATION

A. Preparation of Tree and Shrub Pits:

1. Excavate pits with vertical sides, as specified and as shown on the drawings. For balled and burlapped (B & B) trees and shrubs, make excavations at least half again as wide as the ball diameter and equal to the ball depth, plus an allowance for setting of ball on a layer of compacted backfill. Allow for 6” minimum setting layer of planting soil mixture.

2. Loosen hardpan and moisture barrier to a depth of 2’ minimum below the bottom of the tree pit or until hardpan has been broken and moisture is allowed to drain freely. For shrub pits, loosen hardpan 8” minimum below bottom of excavation or until hardpan has been broken and moisture is allowed to drain freely.

3. For container grown stock, excavate as specified for balled and burlapped stock, adjusted to size of container width and depth.

4. Conduct drainage tests.

5. During planting process fill planting pit excavation to final grade using planting soil mix.

B. Test Drainage:

1. Acceptable Drainage Rate: Minimum acceptable percolation rate for tree pits, shrub pits and shrub/ground cover beds shall be 0.10 inch per hour.

2. Tree and Shrub Pits: Fill each pit with water. If percolation is less than 0.10 inch per hour in a 24 hour period, drill a 12” auger to a depth of four feet below the bottom of the pit. Fill auger hole with 3/4” stone and cover with soil separator. Re-test pit. In case drainage is still unsatisfactory, notify Landscape Architect, in writing, of the condition before planting in such questionable areas. If not, Contractor is fully responsible for warranty of trees.

C. Dispose of subsoil removed from landscape excavations. Do not mix with planting soil, use as backfill or use to construct saucers around plant pits.

3.03 PREPARATION OF PLANTING SOIL MIX

A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.

B. Mix specified soil amendments and fertilizers with topsoil at rates specified. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.

C. For pit and bed type backfill, mix planting soil prior to backfilling.
3.04 PLANTING TREES AND SHRUBS

A. Set plants on 6” of backfill soil mix to such depth that the finished grade level at the plant after settlement will be the same as that at which the plant has grown. They shall be planted upright and faced to give the best appearance or relationship to adjacent structures. No burlap shall be pulled out from under balls. Platforms, wire and surplus binding from top and sides of the balls shall be removed. Roots shall be spread in their normal position. All broken or frayed roots shall be cut off cleanly. Soil shall be placed and compacted carefully to avoid injury to roots and to fill voids. When the hole is nearly filled, add water as necessary and allow it to soak away. Fill the hole to finish grade, and form a shallow saucer around each plant by placing a ridge of topsoil around the edge of each pit. After the ground settles, additional soil shall be filled into the level of the finished grade.

B. Form shallow saucers to the finished grade outside the tree pit approximately 4” - 6” height capable of holding water about each plant by placing a mound of topsoil around the edge of each filled-in pit.

C. If deciduous trees or shrubs are moved in full leaf, spray with anti-desiccant at nursery before moving and again after planting as per manufacturer's recommendations.

D. Mulching: Immediately after planting work has been completed, mulch pits, trenches and planting beds. Provide not less than 3” thickness of hardwood bark mulch as shown on drawings. Apply/incorporate pre-emergence herbicide per manufacturer's instructions. Finish edges according to detail.

E. Water: Soak all plants immediately after planting, continue watering thereafter as necessary until acceptance of the work in total.

F. Smooth planting areas to conform to specified grades after full settlement has occurred and mulch has been applied.

3.05 STAKING, GUYING AND PRUNING:

A. Stake and guy trees immediately after planting. Plants shall be plumb after staking or guying. Maintain stakes, wires and guys until acceptance of the work in total.

B. Staking trees of 1" to 3" caliper:

C. Drive stakes securely into ground and fasten to tree with approved tie material.

D. Adhere to staking details unless alternate detail has been approved by Landscape Architect prior to beginning of planting operation.

E. Staking trees of 1" and under or 4' height:

1. Use single stake with rubber hose and wire loop around trunk.

F. Guy deciduous trees over 3" to 5" caliper and evergreen trees 4'-8’ all as described and detailed.

1. Position guys around trunk at approximately two-fifths the height of the tree.

2. Anchor guys in ground either to steel rods driven securely into ground with top end 3" below finish grade or steel anchors securely screwed into ground with top end at or below finished grade.
3. Flag all guy wires as required.

G. Guy deciduous trees over 5" caliper and evergreen trees over 8' tall as described and detailed.
   1. Install 3 screw anchors minimum equally spaced around the tree at approximately two-fifths the height of the tree.
   2. Securely anchor cable to screw anchors.
   3. Use hose around cable so cable is not in contact with plant.
   4. Secure cable around tree trunk.
   5. Securely attach ends of cable to turnbuckle so that cable is taut before adjusting turnbuckle.
   6. Flag all guy cables as required.

H. Pruning:
   1. Unless otherwise directed by the Landscape Architect do not cut tree leaders, and remove only injured or dead branches from trees, if any.
   2. Prune shrubs at the direction of the Landscape Architect.
   3. Remove and replace promptly any plants pruned or misformed resulting improper pruning.
   4. Paint wounds and cuts over 3/4" in diameter with approved tree paint designed for this purpose.

3.06 MAINTENANCE:

A. Begin maintenance immediately after planting.

B. Maintain trees, shrubs and other plants until Substantial Completion of the entire project and for not less than 30 days after Substantial Completion of the entire project.

C. Maintain trees, shrubs and other plants by watering, pruning, cultivating, weeding, and re-mulching as required for healthy growth.

D. Restore planting saucers.

E. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required.

F. Restore or replace damaged wrappings.

G. Spray as required to keep trees and shrubs free of insects and disease.

3.07 CLEAN UP AND PROTECTION:

A. During landscape work, keep pavements clean and work area in an orderly condition.
B. Upon completion of work, clear grounds of debris, superfluous materials and all equipment. Remove from site to satisfaction of Landscape Architect.

C. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades and trespassers.

D. Maintain protection during installation and maintenance periods.

E. Treat, repair or replace damaged landscape work as directed, at no additional cost to Owner.

3.08 SUBSTANTIAL COMPLETION AND FINAL COMPLETION

A. Upon completion of work, notify Landscape Architect at least ten (10) days prior to requested date of inspection for Substantial Completion. Remove rejected plants and materials promptly from project site.

B. Landscape Architect will review the work and document incomplete or incorrect work in an inspection report or list. If trees, Shrubs, and Groundcovers work is found to be substantially complete a Certificate of Substantial Completion will be issued that establishes a date of substantial completion. The list of incomplete or incorrect work will be attached to the Certificate.

C. Complete or correct Trees Shrubs and Groundcovers work identified on the list within the number of days established in the Certificate of Substantial Completion.

D. Upon satisfactory completion of repairs and/or replacements, the Landscape Architect certifies, in writing, the Final Completion of the work.

END OF SECTION 32.93.00
SECTION 33.27.20
SITE DRAINAGE SYSTEM

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Pipes, culverts and fittings, complete. Catch basins, drop inlets, manholes, end walls and other structures, complete as shown on drawings. Ditch protection and bracing requirements to conform to OSHA requirements and regulations. Piping and drains for sediment basins.

B. Related Work Described Elsewhere:

1. Site Preparation: Section 31.10.00
2. Earthwork: Section 31.20.00
3. Excavating, Backfilling and Compaction: Section 31.22.00
4. Erosion Control: Section 31.25.00

PART 2 - PRODUCTS

2.01 CONDUIT AND EMBEDMENT MATERIALS

A. Furnish fittings of same type and class of material as conduit.

B. Reinforced Concrete Pipe (RCP): ASTM C76, Class III. This pipe may be used in lieu of PVC.

C. Corrugated Metal Pipe (CMP): Helically corrugated 16 gauge galvanized metal uncoated, and conforming to AASHTO-M36. Pipe shall have rerolled ends.


E. Corrugated Polyethylene Pipe: High density polyethylene, corrugated exterior/smooth interior, 12 inch to 36 inch diameters conforming to AASHTO M252 with the addition that the pipe have a smooth interior liner. Material conform to ASTM D3350. Pipe equal to Hi-Q pipe as manufactured by Hancor, Inc.

F. Contractor has the option of using reinforced concrete pipe, polyvinyl chloride pipe or corrugated polyethylene for storm drainage except where pipe is encased in concrete. Do not substitute corrugated metal pipe for any of the above mentioned pipe.

G. Crushed Stone Pipe Bedding Materials: Size #7 or #8.

2.02 CONCRETE MATERIALS

A. Concrete Base: Pre-cast or cast-in-place concrete, at Contractor’s option. Use concrete which will attain a 28-day compressive strength of not less than 3,000 psi.
B. Pre-cast Concrete Structures: ASTM C478, sizes as indicated, eccentric cone pre-cast top, unless otherwise indicated. Pipe openings of proper size shall be carefully and accurately cut in or cast in.

2.03 MASONRY MATERIALS

A. Manhole and Catch Basin Brick: ASTM C32, Grade MS.

B. Sewer Brick: ASTM C32, Grade SS.

C. Masonry Mortar: ASTM C270, Type M. For minor amounts, use packaged materials complying with ASTM C387, Type M.

2.04 METAL ACCESSORIES

A. Manhole Frames and Covers: Grey cast-iron, ASTM A48, Class 30B. Comply with requirements of TDOT for type and style unless otherwise indicated, and equal to J.R. Hoe & Sons, Middlesboro, KY, #MC-325.

B. Catch Basin Frames and Gratings: Grey cast iron, ASTM A48, Class 30 or better. Comply with requirements of TDOT for type and style unless otherwise indicated, and equal to J.R. Hoe and Sons.

C. Curb Inlet and Gratings: Comply with requirements of TDOT for type and style unless otherwise indicated, and equal to J.R. Hoe & Sons.

2.05 EROSION CONTROL STONE

A. Rip Rap: Refer to Section 02205, Erosion Control.

2.06 SUB-DRAIN MATERIALS

A. Polyethylene perforated tubing and fittings shall conform to SCS National Engineering Standard, Code 606, as manufactured by Hancor, Inc., or equal.

B. ASTM F405 or F667, AASHTO M252 or M294, and SCS 606.

C. Filter Stone: Open graded, washed stone such as ASTM No. 57.

D. Filter Sand: Clean concrete sand.

E. Filter Fabric: "Typar".

2.07 DOWNSPOUT BOOTS

A. Downspout boots to be McKinley Standard Cast Iron with one coat of rust inhibitive primer, Type D54. Provide sizes to accommodate downspouts.
PART 3 - EXECUTION

3.01 INSPECTION

A. Installer must examine areas and conditions under which storm sewer system work is to be installed and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

3.02 DRAINAGE STRUCTURES

A. Install at locations indicated and to required elevations. Set rectangular frames square with the nearest wall, building or pavement.

B. Where an inlet is part of the temporary erosion and sediment control measures, leave structure top below grade or leave temporary opening in side to collect water from silt basin sump. Complete installation after basin is no longer required.

3.03 TRENCHING

A. General:

1. Perform all trenching required for the installation of items where the trenching is not specifically described in other sections of these specifications.

2. Make all trenches open vertical construction with sufficient width to provide free working space at both sides of the trench and around the installed item as required for caulking, joining, backfilling, and compacting.

B. Depth: Trench as required to provide the elevations shown on the drawings. Where elevations are not shown on the drawings, trench to sufficient depth to give a minimum of 18" inches of fill above the top of the pipe, measured from the adjacent finished grade.

C. Correction of Faulty Grades: Where trench excavation is inadvertently carried below proper elevations, backfill with material approved by the Designer, and then compact to provide a firm and unyielding subgrade and/or foundation to the approval of the Designer and at no additional cost to the Owner.

D. Trench Bracing:

1. Properly support all trenches in strict accordance with all pertinent rules and regulations including current OSHA excavation and trench safety standards. The existing soil on the site should be classified as a Class C soil type.

2. Brace, sheet, and support trench walls in such a manner that they will be safe and that the ground alongside the excavation will not slide or settle, and that all existing improvements of every kind, whether on public or private property, will be fully protected from damage.

3. In the event of damage to such improvements, immediately make all repairs and replacements necessary to the approval of the Designer and at no additional cost to the Owner.
4. Arrange bracing, sheeting, and shoring so as to not place stress on any portion of the completed work until the general construction thereof has proceeded far enough to provide sufficient strength.

E. Removal of Trench Bracing: Exercise care in the drawing and removal of sheeting, shoring, bracing, and timbering to prevent collapse and caving of the excavation faces being supported.

F. Grading and Stockpiling Trenched Material: Control the stockpiling of trenched material in a manner to prevent water running into the excavations. Do not obstruct surface drainage, but provide means whereby storm and waste waters are diverted into existing gutters, other surface drains, or temporary drains.

G. Foundation for Pipes:

1. General: Grade the trench bottoms to provide a smooth, firm, and stable foundation free from rock points throughout the length of the pipe.

2. Foundation Material: Place a minimum of six (6") inches of the specified cohesionless material in the bottom of the trench.

3. Subsurface Conditions: In areas where soft, unstable materials are encountered at the surface upon which cohesionless material is to be placed, remove the unstable material and replace it with material approved by the Designer. Make sufficient depth to develop a firm foundation for the item being installed.

4. If the need for such overexcavation has been occasioned by an act or failure to act on the part of the Contractor, make the overexcavation and replacement at no additional cost to the Owner.

5. Shaping: At each joint in pipe, recess the bottom of the trench as required into the firm foundation in such a manner as to relieve the bell of the pipe of all load and to ensure continuous bearing of the pipe barrel on the firm foundation.

6. Accurately shape all pipe subgrade and fit the bottom of the trench to the pipe shape. Use a drag template shaped to conform to the outer surface of the pipe if other methods do not produce satisfactory results.

H. Bedding for Pipes:

1. General: Place the specified cohesionless material in the trench, simultaneously on each side of the pipe for the full width of the trench, to a maximum depth of three feet and a minimum depth of one foot above the outside diameter of the pipe barrel.

2. Densification: Densify the bedding material after placing by slicing with a shovel.

3. Take special care to provide firm bedding support on the underside of the pipe and fittings for the full length of the pipe.
I. Backfill for Pipes:

1. Using On-Site Materials: After the pipe has been thoroughly bedded and covered, spread the on-site material in uniform lifts of not more than eight (8") inches in uncompacted thickness, and then compact as specified in this section. Repeat the spreading and compacting procedure until adjacent grade level is attained.

3.04 INSTALLATION OF PIPE

A. General: Install pipe in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated. Inspect pipe before installation to detect any apparent defects. Mark defective materials with paint and promptly remove them from the site.

B. Lay pipe beginning at the low point of a system, true to the grades and alignment indicated with unbroken continuity of invert. Place bell ends or groove ends of pipe facing upstream. Install gaskets in accordance with manufacturer's recommendations for the use of lubricants, cements and other special installation requirements.

C. Installation by Type of Pipe:

1. Concrete Pipe: Install in accordance with applicable provisions of the American Concrete Pipe Association "Concrete Pipe Field Manual", unless otherwise indicated.

2. Plastic Pipe & Corrugated Polyethylene Pipe: ASTM D2321-89, with compacted stone aggregate bedding, and in accordance with pipe manufacturer's written instructions.

3. Refer to drawings for backfill and bedding requirements.

3.05 CLEANING PIPE

A. Clear the interior of pipe of dirt and other superfluous material as the work progresses. Maintain a swab or drag in the line and pull past each joint as it is completed. Flush lines between structures to remove collected debris. Place plugs in the ends of uncompleted pipe at the end of the work day.

3.06 INTERIOR INSPECTION

A. Inspect pipe to determine if line displacement or other damage has occurred. Inspect lines between manholes or structures after approximately two feet of backfill is in place, and again at completion of the project. If the inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects, correct such defects.
3.07 STRUCTURES

A. Masonry Construction (Contractor's option in lieu of concrete unless otherwise indicated):
   1. Use sewer brick to construct masonry manholes. Mix mortar with only enough water for workability. Retempering of mortar will not be permitted. Keep mortar mixing and conveying equipment clean. Do not deposit mortar upon, or permit contact with, ground.
   2. Lay masonry in mortar so as to form full bed with ends and side joints in one operation, and with full bed and vertical joints, not more than 5/8 inch wide. Protect fresh masonry from freezing and from too rapid drying. Where structures occur, set tops of frames and covers flush with finish surface.

B. Pre-cast Concrete Construction (Contractor' option in lieu of masonry, unless otherwise indicated):
   1. Place pre-cast concrete sections as shown on the drawings. Where manholes, set tops of frames and covers flush with finish surface. Use epoxy bonding compound where manhole steps are mortared into manhole walls. Provide rubber joint gasket complying with ASTM C433 or apply bituminous mastic sealant at joints of sections.

C. Poured-in-Place Concrete: In accordance with Division 3.

3.08 EROSION CONTROL STONE

A. Install filter cloth then hand place rip rap as indicated.

3.09 TESTING

A. Perform testing of completed conduits and structures in accordance with local authorities having jurisdiction and the Designer. Correct unsatisfactory conditions.

END OF SECTION 33.27.20
SECTION 33.46.13

FOUNDATION DRAINAGE SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provide foundation drainage at below grade walls adjacent to inhabited space. Drainage pipe shall be perforated polyvinyl chloride pipe and shall be placed on crushed stone and surrounded by drainage fill. Drainage fill material shall be overlaid with layer of filter fabric before placement of finish soil materials.

END OF SECTION 33.46.13
SECTION 33.49.00

WATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: The Contractor, and/or a manufacturer selected by the Contractor and approved by the Engineer of Record, shall furnish all labor, materials, equipment and incidentals required design and install all precast concrete stormwater treatment structures and appurtenances in accordance with the Drawings and these specifications. The Water Quality Device shall provide non flow partitioned treatment that removes sediment, free floating pollutants, and hydrocarbon particles, storing the free floating pollutants in a separate internal device. The water quality device must not include an internal bypass partition for the redirection of flows greater than the Water Quality Flow (WQF), this means 100% of the flow entering the device during any given storm event shall be treated.

B. Referenced Sections:

1. Section 33.27.20 – Site Drainage System.

1.02 REFERENCED STANDARDS

A. ASTM International (ASTM):

1. A 48-03 – Specification for Gray Iron Castings
2. B 209-06 – Specification for Aluminum and Aluminum Alloy Sheet and Plate
8. D-3977 Suspended Solids Concentration Analysis

1.03 SUBMITTALS

A. Product Drawings: Manufacturer/Supplier shall submit for approval product dimensional drawings as the basis for preparation of fabrication drawings. Included with the drawings shall be a hydraulic design package detailing the site specific design of this device. Product drawings shall be submitted to the Engineer of Record for review and approval in accordance with Section 01.30.00.
1.04 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: A Manufacturer/Supplier that shall have been regularly engaged in the design and production of water quality devices for the physical treatment of stormwater runoff for a minimum of 5 years and be able to provide maintenance records on more than 30 systems for over 5 years demonstrating the field performance of their products.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Acceptable Manufacturers: Unless a list of approved manufacturers is provided in the specification the Water Quality Device will be provided by CrystalStream Technologies, 2090 Sugarloaf Parkway, Suite 135, Lawrenceville, GA 30045, Phone: 800-748-6945 or approved Equal in accordance substitutions must be approved by Local Building Officials prior to being used as a bases for Bidding this project.

2.02 PERFORMANCE

A. Each water quality device shall adhere to the following performance specifications at the design treatment capabilities, as listed below:

<table>
<thead>
<tr>
<th>TABLE 2.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mark No.</td>
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<td>-----------</td>
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<tr>
<td>M846</td>
</tr>
</tbody>
</table>

CFS = Cubic Feet Per Second; GPM = Gallons Per Minute
Minimum Peak Flow: 16.0* cfs
** Hydraulic Loading Rate is the Water Quality Flow Rate converted to GPM divided by the treatment surface area of the device equals GPM/ft²

1. Water Quality Flow Rate is the maximum flow at which the system will remove 80% of the annual sediment scoured from the pervious acres of the site.

2. Unless specified by the owner, pavement washoff of sediment solids shall be assumed equal to 2000# per year per acre of pavement draining to the device. Using these values the device shall provide adequate storage to allow for a 6 month maintenance interval.

3. Product substitutions must be equal to or less than the specified Hydraulic Loading Rate defined above for each unit.

*Values are subject to a ± 15% variation – allow for variance in cost of unit.

B. Each water quality device shall include a rectangular chamber with a series of aluminum baffles and filter baffle to aid in the collection and storage of sediment, free floating debris, and hydrocarbons. The water quality device will also provide a section in the chamber to separate hydrocarbons from the flow entering the device.

100% DESIGN DEVELOPMENT SUBMITTAL
ISSUED: 3/13/2017
C. Each water quality device shall be capable of removing 80% of the net annual sediment load based on a particle size gradation as defined by the site characteristics.

D. Annual removal efficiency models shall be based on laboratory performance data, site specific hydraulics and hydrology, and local rainfall data. Individual water quality devices shall have the Design Treatment Capacity listed in Table 2.1, and shall not allow for bypass when flows exceed these flows.

E. Direct access to the internal components of the device shall be provided by a combination of cast iron grate and frame, ring and cover or aluminum hatches. Hatches shall have a minimum access opening dimension of 36 inches square to facilitate maintenance and/or repairs.

F. Water quality device shall be housed within one single rectangular structure with a sump depth not exceeding 5 feet. Sump depth is defined as the measurement from the invert of the outlet pipe to the top of the base inside the structure.

G. A trash rack or other separation device shall be provided to capture floating debris.

H. Individual Water Quality unit(s) shall have usable sediment storage capacity of not less than the corresponding volume(s) listed in Table 2.1. The system shall be designed to not allow surcharge of the upstream piping network during dry weather conditions.

I. The spill protection capacity, under normal conditions, where the ambient water level in the front portion of the vault can be replaced with spill material shall be 600 gallons minimum. In an artificial or emergency situation where the downstream pipe is blocked, the maximum spill storage capacity, above the trapped ambient water shall be 800 gallons minimum. This volume does not include storage in the upstream piping system.

J. This unit is subject to traffic loadings and shall be constructed with 5,000 psi, 6" reinforced floor, walls, and a 6" reinforced concrete lid.

K. A 2.00 ft. riser/lid combination above the unit shall be constructed in the same manner as the walls.

L. A 3’ x 2’ grate and a 24” manhole in the concrete lid shall be provided for access and cleaning. Contractor will be required to build up in the field to match final grade.

M. A separate oil chamber shall be provided with an adjustable weir. This weir will be set at the approximate 6 month, 30 minute storm intensity, so that oil should be pushed over the skimmer at least once during two clean out cycle periods. The weir shall be adjusted based on actual field results.

N. The exit pipe, when evaluated as a submerged circular orifice under inlet control shall be sufficient to pass the 25 year flow coming to the unit as configured.

O. Design system for maximum flow rate for 1.83 acres impervious area.
2.03 PERFORMANCE VERIFICATION

A. Valid full scale field testing using (ASTM D-3977) SSC method of sampling analysis, monitored by a third party entity with experience in stormwater field monitoring is required.

B. Full Scale Laboratory testing completed by an independent laboratory to develop performance curves under known conditions is required. Laboratory Testing alone is not sufficient to provide sufficient proof of scaling methodology.

C. A list of jurisdictions served by the manufacturer should be provided to verify supply, installation, inspection, maintenance, and performance claims.

D. A list of 30 installations including owner, contractor, engineer, and jurisdiction contact information must be provided.

2.04 MATERIALS

A. The Water Quality Unit shall be housed in a concrete structure that conforms to ASTM C 857 and ASTM C 858 and meet the following additional requirements:

1. In all cases the wall thickness shall be no less than the minimum thickness necessary to sustain HS20-44 (MS18) loading requirements as determined by a Licensed Professional Engineer.

2. Sections shall have a shiplap or tongue and groove joint with a butyl mastic sealant conforming to ASTM C 990.

3. Cement shall be Type I, II, or III Portland Cement conforming to ASTM C 150.

4. All sections shall be cured by an approved method. Sections shall not be shipped until the concrete has attained a compressive strength of 4000 psi or other designated suitable handling strength.

5. Pipe openings shall be sized to accept pipes of the specific size(s) and material(s), and shall be sealed by the contractor with a hydraulic cement conforming to ASTM C 595.

B. All internal components shall be of aluminum alloy in accordance with ASTM B 209.

C. Brick or masonry used to build the grate and frame or ring and cover to grade shall conform to ASTM C 32 or ASTM C 139 and shall be installed in conformance with all local requirements.

D. Castings for manhole frames and covers/grates shall be in accordance with ASTM A 48, CL.30B and AASHTO M105.
PART 3 – EXECUTION

3.01 INSTALLATION

A. Each Water Quality Unit shall be constructed according to the size shown on the Drawings as specified herein. Install at elevations and locations shown on the Drawings or as otherwise directed by the Engineer.

B. Place the pre-cast base unit on a granular sub-base of minimum thickness of 6 inches after compaction or of greater thickness and compaction if specified elsewhere. The granular sub-base shall be checked for level prior to setting, and the pre-cast base section of the unit shall be checked for level at all four corners after it is set. If the slope from any corner to any other corner exceeds 0.5% the base section shall be removed and the granular sub-base material re-leveled.

C. Prior to setting subsequent sections place bitumen sealant in conformance with ASTM C990 along the construction joint in the section that is already in place.

D. After setting the pre-cast roof section of the Water Quality Unit, set pre-cast concrete grade rings or bricks to bring the grate and frame, ring and cover or hatch to finished grade in accordance with local standards.

E. Holes in the concrete sections for handling or other purposes shall be plugged with a non-shrink grout or by using grout in conjunction with concrete plugs.

F. Where holes must be cut in the pre-cast sections to accommodate pipes, do all cutting before setting the sections in place to prevent and subsequent jarring which may loosen the mortar joints. The Contractor shall make all pipe connections.

END OF SECTION 33.49.00
**LANDSCAPING:**

With the exception of seeded lawns, all landscaped shall be irrigated. Trees shall provide structure, seasonal interest and shade for pedestrians while complimenting the architecture of the Fine Arts Center. Deciduous shade trees are proposed along the western property line to buffer the adjacent property and to utilize solar properties to cool the building in summer and warm it in winter. Small-scale evergreen trees are proposed to screen views of utilities and the service/loading dock area. Shade trees are proposed around the service drive/rear lawn to provide shade in summer while maintaining an open lawn for future parking expansion (Design Option No. 1.) Street trees are proposed behind the drop-off and along State of Franklin Road while Ornamental trees are proposed along the western portion of the sidewalk.

Sloped banks between the sidewalk along State of Franklin Road and the plaza in front of the building shall be planted with native grasses Mix ‘A’ (installed as 2” plugs @ 18” on center) which will grow to fill the planters with a 36” ht.+/- ground cover. Areas planted with plugs will be mulched to help control weeds as the plants establish during the first two years. When established, the native grasses will require minimal maintenance (mulch, weeding, fertilizers, water and mowing.)

The sloped bank in front of the central façade shall be planted with evergreen shrubs and groundcovers to provide color and structure all year and to open street views towards the façade. A rectilinear planter at street level shall be planted with a mix of daylilies and daffodils to provide yellow seasonal color during spring and summer.

A planting bed within the plaza near the corner of the building shall be planted with a specimen, conical-shaped evergreen tree and a spreading groundcover with pronounced blue flowers in spring. The adjacent trapezoidal-shaped planting bed contains an ornamental tree with shrubs and ground covers on the steeper portions of the slope. The remainder of the bed is planted with a spreading perennial which blooms gold flowers throughout the Spring season.

Stairs and circular ramps allow pedestrians to transition from the entrance plaza level of the ETSU Fine Arts Center to the lower level of the adjacent Millennium Centre. Sodded, irrigated fescue lawns are proposed for the slopes of the circular transition element and for rectilinear spaces between the two buildings. The proposed lawns provide multi-use space for events or informal gatherings. Three (3) existing Bald Cypress trees between the buildings shall be protected during construction retained.

The circular multi-purpose pedestrian space east of the building is enhanced with bands of perennials which flower in blue and gold colors in spring and fall. Preference has been given to evergreen and semi-evergreen varieties. Evergreen shrubs and ground covers ‘anchor’ the corners while ornamental trees assist with defining the space.

Flowering shrubs and ornamental grasses are proposed adjacent to the eastern and western building foundations.

The dead-end terminus of the unnamed City street which serves the adjacent bank property and the Fine Arts Center parking area shall remain. A retaining wall shall be constructed near the property line to provide grade transition between the street level and the Fine Arts Classroom Building. The area between the wall and street shall be planted with large shrubs to soften the appearance of the wall and discourage pedestrians from traversing the wall.

Option No. 3 is located within the southern portion of the adjacent bank property. In order to provide enhanced pedestrian access to the Fine Arts Center from the existing parking garage located southwest of the property, the sidewalk could be expanded from the corner of the intersection at an angle to blend smoothly into the angled pedestrian ramp serving the Fine Arts Center. If Option 3 were constructed, three (3) street trees would be provided and turf grasses would be installed on the reconfigured slope required to construct the expanded sidewalk. The ornamental planting associated with the bank’s sign would be re configured to include evergreen shrubs and native grasses due to revised grading required on the bank’s property.
DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 32.80.00 – LANDSCAPE IRRIGATION SYSTEM

Provide a complete automated underground irrigation for all sodded lawns and all planting beds. (No irrigation is proposed for seeded lawns northwest of the building. System shall include materials and installation including, but not limited to: piping, fittings, sprinkler heads, drip tubing, valves, controller, sensors, wire and sleeves beneath paved surfaces. The system shall utilize a dedicated water meter as shown on the Civil drawings.

The controller shall be ET-based and weather sensing.

The landscape irrigation system shall be zoned to provide separate watering schedules for sodded lawns versus shrubs/groundcovers versus drip irrigation and as required to provide adequate pressure. All zones shall utilize head-to-head coverage. Due to the relatively low static pressure of 80 PSI, the system may require a booster pump. The system shall utilize less than 50% potable water as compared to a standard system in accordance with Sustainability Guidelines.

Two (2) 4” diameter PVC sleeves shall be provided at all pavement crossings; one for irrigation lines and the second, empty sleeve for future use.

SECTION 32.91.19 – LANDSCAPE GRADING

Install topsoil for landscaping at depths as shown on the drawings. Existing topsoil will be removed and stockpiled on site during site preparation. Typical topsoil depths required are: 3” at sodded lawns, 4” at seeded lawns, 6” at areas of mass planting of shrubs and/or groundcovers and 4” at areas of native grass/forbs plugs. Landscape grading includes preparation of the subgrade prior to topsoil installation, placement of the stockpiled topsoil in planting areas at specified depths and removal of foreign material larger than 1” in size. Landscape grading includes preparing finished grades to ½”+/-.

SECTION 32.92.19 – SEEDING

Establish fescue lawns at locations indicated on the drawings from approved blend of three (3) fescue seed varieties. Seeding includes preparation of substrate as recommended on the Topsoil Test Report, seed, straw mulch, starter fertilizer and water.

SECTION 32.92.23 – SODDING

Establish fescue lawns at locations indicated on the drawings utilizing fescue sod. Sodding includes preparation of substrate as recommended on the Topsoil Test Report, fertilizer, cutting/trimming sod, sod staples on slopes, watering and rolling with a light lawn roller.

SECTION 32.93.00 – TREES, SHRUBS AND GROUNDCOVERS

Provide and install trees, shrubs and groundcovers at locations indicated on the drawings. Submittals are required to demonstrate that plant sources and quality are as specified on the Plant List/Schedule. Plant installation shall include accessories such as tree-guys, metal bed edges, mulch, fertilizer, erosion control blankets for groundcovers installed on 3:1 or steeper slopes, etc. Areas of mass planting (shrub beds, ground cover beds, beds with evergreen trees) and 48”-60” diameter rings around deciduous trees shall be mulched with shredded hardwood mulch at 3” depth. Plant sizing and grading standards shall comply with the “American Standard of Nursery Stock.”
PERFORMANCE EQUIPMENT
BUDGET AND DESCRIPTION

Fine Arts Classroom Building
East Tennessee State University
Johnson City, TN

UPDATED 05 March, 2017
INTRODUCTION

This document describes the proposed performance lighting, rigging, and drapery systems anticipated to support events in the renovation and construction of the new Fine Arts Classroom at East Tennessee State University. Equipment description and requirements for audio-visual and IT systems are provided by others under separate cover. The performance equipment systems described herein encompass specialty performance equipment systems only and do not consider the supporting infrastructure including architectural components and building systems. The estimate has been developed based on the currently understood building program and initial programming meetings with the users, although we anticipate modification as the building design progresses.

SUMMARY

The system represents equipment deployable in a flexible fashion. Although the systems are described as discrete systems, in reality, portable equipment will be shared between spaces.

The budget is divided between base bid elements and fittings furnishings and equipment (FFE). An item went into base bid only if it is necessary as part of construction. Any item that could be purchased outside of the construction contract and be installed at a later date has been placed in one of the FFE categories. FFE equipment, not needing integration into the building systems could be purchased directly by the owner and yield a cost savings.

The budget assumes the use of LED lights which cost a premium; however that premium is offset in a reduction in dimming equipment, electrical feeds and a significant downsizing the mechanical system. It also assumes incorporation of some of the owner’s current equipment.

Budget Summary:

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<tr>
<th>Space</th>
<th>Base</th>
<th>FFE</th>
<th>Total</th>
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<td>Recital Hall</td>
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<td>Shops</td>
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Notes:

A division between Base and FFE is a recommendation for a purchasing strategy. Further discussion is necessary to determine the most effective approach.

Estimated costs represent anticipated bid prices in 4th Q 2016 dollars as received from specialty subcontractors.

Estimated costs do not include: architectural, structural, mechanical or electrical systems. Shipping handling, taxes, contingency, contractor overhead and profit are also not included.

Theatre Consultants Collaborative, Inc has no control over the cost of labor, materials or equipment, the contractor’s methods of determining the bid prices, or over competitive bidding, market or negotiating conditions. Accordingly, TCC cannot and does not warrant or represent that bids or negotiated prices will not vary from any estimate of the Construction cost or evaluation prepared or agreed to by TCC.
SHARED COMPONENTS

Although allocated for budget reasons per space there are several shared components. These include:

1. Performance lighting consoles, instruments and accessories.
2. Portable seating.
3. Portable platforms.
4. Shop and stage equipment.
5. Ladders and telescoping work platforms.

MAIN AUDITORIUM

The Theatre is planned to be equipped with a complement of performance equipment systems intended to allow the use for a variety of events including theatre, musical theatre, dance, and other presentations.

The rigging system is a counterweight system. Chain motors and truss are provided for educational purposes.

A basic drapery set is budgeted with main curtain, legs, borders, scrims and a cyclorama. Tracks are provided for the travelers and the main curtain. Acoustical drapery has been budgeted as requested by the acoustician.

Motorized adjustable acoustical drapery, track, and banners are budgeted based on the anticipated needs of the acoustician. Acoustical panels, drapery, track and motorization has been budgeted based on requirements articulated by the acoustical consultant.

An orchestra pit lift is budgeted to allow the adjustment of the orchestra pit from pit level, to seating or stage level with minimal time and labor.

The performance lighting system is designed to be primarily LED based. A motorized breaker panel is budgeted for switched performance and architectural circuits as well as sequence on 3 phase power for distribution to the electrics. A few portable backpack SCR dimmer are budgeted for educational purposes. An Emergency Lighting Transfer Switch (ELTS) is also budgeted. There will be an architectural control system for work and house light control and for simple events. This system will have vacancy detection active for worklights. The console will be a high channel count console optimized for use with LED based fixtures. The space will have a thorough control signal distribution. The stage will be mostly soft power distribution using 6 circuit multiconductors to bring power to the electrics.

Performance lighting instruments include mostly LED equipment with some conventional fixtures for educational purposes. A small quantity of moving light fixtures are also budgeted. Followspots are provided.

An acoustical shell is budgeted based on a Wenger Diva.

Seating is budgeted as a comfortable, durable but quality chair.
STUDIO THEATER

The Theatre is planned to be equipped with a complement of performance equipment systems intended to allow the use for a variety of events including small concerts, theatre, musical theatre, dance, banquets and other presentations. The focus of this venue will be primarily geared towards student use.

Based on discussions with the users in the spring, the overhead support and access has been changed to a tension wire grid system with integrated pipe grid.

A basic drapery set is budgeted legs, borders, scrims and a cyclorama.

Perimeter acoustical drapery is provided.

The performance lighting system is designed to be primarily LED based. A motorized breaker panel is budgeted for switched performance and architectural circuits as well as sequence on 3 phase power distribution to the catwalks. A few portable backpack SCR dimmer are budgeted for educational purposes. An Emergency Lighting Transfer Switch (ELTS) is also budgeted. There will be an architectural control system for work and house light control and for simple events. This system will have vacancy detection active for worklights. The console will be a high channel count console optimized for use with LED based fixtures. The space will have a thorough control signal distribution.

Performance lighting instruments include mostly LED equipment with some conventional fixtures for educational purposes. Followspots are provided.

Seating and portable seating platforms are budgeted as a comfortable, durable but quality chair.

RECITAL HALL

An allowance for motorized acoustical drapery and track is budgeted based on input from the acoustician.

The lighting system is envisioned to be a simple architectural control system with fixed top lighting on the performance platform and focusing front light at the forestage one set optimized for music performance and a second set optimized for video. Occupancy sensing is provided. One small console is provided to share with other rooms. Switched power devices and controls are budgeted.

Presentation lighting is budgeted to be LED based front light.

Seating is budgeted as a comfortable, durable but quality chair.

MUSIC CLASSROOMS 1

Adjustable acoustical drapes and tracks are budgeted per the requirements of the acoustician.

SHOPS

An allowance for tools have been provided to support the shops.
EQUIPMENT SYSTEMS GENERAL DESCRIPTIONS

Stage Drapery

1. The main drape and valance will be of 25oz inherently flame retardant velour (color to be selected by the architect) sewn 100% full and lined with black ranger cloth.

2. The legs, borders, tabs and flat panels will be of flat black 25oz inherently flame retardant velour drapery sewn flat. These panels will have a pipe pocket at their base.

3. Midstage and upstage traveler panels will be of 25oz black inherently flame retardant velour sewn 100% full and lined with black ranger cloth.

4. The cyclorama and scrim will have a pipe pocket at their base.

Acoustical Draperies and Devices

1. The acoustic drapes panels are budgeted as 25oz inherently flame retardant velour drapery (color to be selected by the architect) sewn 100% full with lining.

2. Tracked acoustic drapery will be run manually where accessible, otherwise motorized.

Drapery Tracks

1. Manually operated rope drawn tracks will be provided for the stage traveler draperies.

2. Motorized tracks will be provided for the acoustic drapery where pull lines would be inaccessible. ADC drapery motors or equal.

Performance Rigging

1. Counterweight System
   The counter weight system will be a single purchase system with a T-bar track array for linesets located on 8” centers. This system will be designed to carry 25#/Lf of load in its pipes. A complement of weight will be provided.

2. Temporary Rigging
   Building structure will be provided and sized for portable rigging equipment.

3. Pipe Grid
   This is a 5’x5’ or 6’x6’ grid of lighting pipe arrayed across the entire room. This provides a hanging point for lighting, drapery, and small scenery.

Performance Powered Rigging

1. Power Batten lines - Fixed Speed
   These are preset controlled linesets that allow the raising and lowering of orchestra shell ceiling panels onstage without the use of counterweights for overly heavy linesets. The system will be JR Clancy
Powerlift or equal. Alternatively, a counterweight assist system may be considered as design is investigated.

2. Chain Hoists and Truss
Aluminum trussing will be provided to suspend. Trusses will be raised by chain motors, and then connected to the structure above via wire rope safety cables. Hoisting system over the audience zone would be designed to meet manufacturer requirements for chain motor suspension.

3. Chain Hoists
Single fall 1 ton chain hoists shall be provided with a minimum 5:1 safety factor for hoisting boom lighting trees and other equipment over the stage. Hoists will be designed specifically for hoisting, but not for continuous suspension of loads over personnel. Columbus McKinnon, R&M Materials, or similar.

4. Hoist Control System
A basic programmable, computerized control system will be included to locate and control the hoists. A portable hoist control system is provided for the chain hoists. Motion Laboratories, Niscon, or similar.

5. Proscenium Safety Curtain
The code required proscenium protection between the stage and audience, and will be achieved with a safety curtain. It will be winched to facilitate regular operation, and will be framed due to the width of the proscenium.

Seating Platforming
A platforming system will be provided for different rooms for use in creating stepped audience seating in a variety of configurations. This system will include a legging system that utilizes 1-½” (nominal) pipe legs, a modular railing system, and storage carts. Staging Concepts, Stageright, Wenger, or similar.

Tension Wire Grid
A woven, modular tension wire grid is designed to provide a walking surface through which lights may be shined and spotlines may be run. The grid will be installed in approximately 8’ square modules with structural supports from the ceiling. The structural support system will include 1.9” OD pipe hangers at the intersections of the panels. These pipes allow the use of standard lighting pipe to create lighting positions throughout the room.

Stage Pit Lift
A mechanized system would be provided for use in changing the elevation of the front of the stage. The system is designed to function as a pit floor, a stage extension, and/or additional seating depending on the height it is set to. This system will include a safety system with astragals and door interlocks. The system would employ a low profile drive which would not require caissons but would necessitate a mechanical depression 4’-0” below the lowest playing elevation. Serapid Linklift, Gala Spiralift, or similar.

Performance Dimming and Controls

1. Dimmers, Switching And Distribution
   A. SCR based dimmers will be provided in sufficient quantity to service the anticipated uses. They will have a moderate rise time to minimize their noise output. ETC Sensor or equal
   B. Motorized Breaker Panel Board
      This is a panel board employing motorized breakers that will be controlled via DMX signals from the performance lighting control system. This will also control multipole contactors for switching higher amperage distribution. LynTec RCP Series or equal
C. Busway will be high amperage 3 phase distribution system with taps that can be installed at any point on the busway to provide the required amperage / phase configuration. The system will not require powering off to insert or remove a tap. Universal Electric Corporation Starline Busway B100A or equal.

D. Additional circuit distribution will be via plug boxes with 2 pin and ground (2PG) stage connectors.

2. Control Console
   The control console will be a computerized console. The console will be ETC ION equal.
   The small control console will be a computerized console. The console will be ETC Element equal.

3. Architectural Lighting Control System
   This is a work and house light control system provides a basic level of control for the performance and audience areas. The architectural control will include programmable stations at entries for basic operation, and a touch panel for moderate preset controls for certain events not requiring the full capabilities of a control console.

4. Control System and Distribution
   A. The control system will be a DMX driven system transported over Ethernet in a standards compliant format. The system will utilize portable, user configurable nodes that accept and distribute DMX-512A information. These nodes will be powered over the Ethernet cabling in a manner compliant with the IEEE Power Over Ethernet standard. Some devices in the system will be native to the Ethernet system, such as the architectural controller and the dimmers.

5. Company Switch, Emergency Lighting Transfer Switch
   A. Company Switch
      UL rated Company switches with connection provisions for cam-lok connectors and bare leads. These switches will include lock-out provisions and shunt trip breakers that de-energize the unit when live components are exposed. One company switch will be provided with an isolated ground for the sound system. Union Connector or equal

   B. Emergency Lighting Transfer Switch
      If required due to a generator or inverter backup source, a code-compliant transfer switch will be provided to transfer power supplied to selected hard wired architectural lighting fixtures from the normal feeds (via relays and dimmers) to constant emergency power sources. Union Connector or equal

Performance Lighting Instruments and Accessories
This equipment encompasses the lights, cable, booms, and other portable equipment involved in placing lights on stage.

1. LED Ellipsoidal Instruments
   ETC Source4 LED Lustr+ & Studio HD or Equal

2. Conventional Ellipsoidal Instruments
   ETC Source4 or Equal

3. LED Wash Instruments
   ETC D-40 Lustr+ or Equal

4. Followspots
   Lycian or Equal
Performance Equipment Budget and Description
East Tennessee State University
UPDATED 30 January, 2017

5. Moving Lights
   Martin 350 Entour or equal

6. Portable Dimmers For Conventional Lights
   ETC ES750, Strand Light Pack or equal.

Performance Sound, Video & Communications Systems

1. This equipment is budgeted by others.

Acoustical Shell
This system of towers and ceiling panels is designed to provide a demountable enclosure to be used in support of acoustical music. It assists the audience in hearing the performers and the performers in hearing themselves. It also creates a visually complete enclosure on stage. Pricing is based on a Wenger Diva Shell.

Portable Dance Floor
A "Marley" type floor designed to provide good traction and a smooth surface.

Fixed Audience Seating

Stage Equipment

1. An allowance is provided for a basic inventory of loose items for all programmed shop spaces.

2. A modest amount for power tools is included for the scene shop.

3. Pneumatic compressor and plumbing to the stage will allow use of pneumatic materials, as well as easy access to pneumatic automation on the stage.

4. Washers, dryers, steamers, and other wardrobe and costume maintenance materials are budgeted as an allowance.

5. Telescoping Work Platform is a relatively light weight platform that allows a technician access to the pipe grid. An allowance for stepladders is also included.

APPENDICES

Equipment Budget

Find attached itemized spreadsheet of performance equipment allowances.
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#### 11069 / 11 61 13 Subtotal

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### Performance Stage Machinery - 11941 / 11 61 39

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### Fine Arts Classroom Building

East Tennessee State University

100% Design Development

UPDATED 3/5/2017

Performance Equipment Budget

Page 2 of 5
| Item | Description | FTE | Unit | Unit Cost | Qty | Total | Qty | Total | Qty | Total | Qty | Total | Qty | Total | Notes |
|------|-------------|-----|------|-----------|-----|--------|-----|--------|-----|--------|-----|--------|-----|--------|
| 57   | DMX Distr Equipment (1 universe/w 6 outs) | Each | 2,200 | 2,200 | 1 | 2,200 | 1 | 2,200 | - | - | - | - | 4 | 8,800 |
| 58   | Control Faceplate | Each | 300 | 7,200 | 1 | 7,200 | 4 | 12,800 | 16 | 48,000 | - | - | - | - | 44 | 13,200 |
| 59   | Base Processing | System | 7,600 | 1 | 7,600 | 1 | 7,600 | 1 | 7,600 | - | - | - | - | 3 | 22,800 |
| 60   | 2 Port DMX Node | Each | 980 | 9,820 | 0 | 0 | 8 | 7,840 | - | - | - | - | 17 | 16,660 |
| 61   | 4 Port DMX Node | Each | 2,700 | 10,800 | 1 | 2,700 | 1 | 2,700 | - | - | - | - | 6 | 16,200 |
| 62   | Node Power (Power Over Ethernet Switch) | Each | 2,200 | 2,200 | 1 | 2,200 | 1 | 2,200 | - | - | - | - | 4 | 8,800 |
|      | Allowance For Architectural Lighting | Each | 5,000 | 5,000 | 1 | 5,000 | 5,000 | 5,000 | - | - | - | - | 3 | 15,000 |
| 64   | Stage Lighting Instruments - Ellipsoidal long throw | Each | 660 | 30,000 | - | - | - | - | 30 | 19,800 |
| 65   | Stage Lighting Instruments - Ellipsoidal Moderate or short throw | Each | 375 | 11,250 | 0 | 0 | - | - | - | - | 30 | 11,250 |
| 66   | Stage Lighting Instruments - LED Ellipsoidal Moderate or short throw - RGBLime | Each | 1,350 | 182,250 | 16 | 21,600 | 40 | 54,000 | - | - | 191 | 257,850 | ETC Source4LED Lustr+ |
| 67   | Stage Lighting Instruments - Pars | Each | 230 | 6,900 | - | - | - | - | 30 | 6,900 |
| 68   | Stage Lighting Instruments - LED Wash RGBLime | Each | 850 | 54,400 | 15 | 12,750 | 27 | 22,950 | - | - | 106 | 90,100 | ETC Color Source PAR |
| 69   | Cyc Lighting Instruments 1 Cell - LED | Each | 1,800 | 32,400 | - | 7 | 12,000 | - | - | - | 25 | 45,000 | Chroma Q Color Force2 |
| 70   | Follow Spots - Short Throw | Each | 4,250 | 12,750 | - | - | - | - | 30 | 12,750 |
| 71   | Lighting Accessories | Each | 330 | 10,230 | 31 | 1,575 | 85 | 3,825 | - | - | - | - | 220 | 11,550 |
| 72   | Portable dimmer at conventional instrument - 750 W | Each | 450 | 5,400 | - | 10 | 4,500 | - | - | - | - | 22 | 9,000 |
| 73   | LED Automated Light | Each | 10,500 | 94,500 | 2 | 21,000 | - | - | - | - | 11 | 155,500 | High End Sola Spot |
| 74   | Control Cable | Each | 55 | 3,160 | 10 | 3,160 | 62 | 3,610 | - | - | - | - | 210 | 11,550 |
| 75   | Loose Electrical Distribution - Sd | Each | 55 | 18,205 | 31 | 1,705 | 86 | 4,730 | - | - | - | - | 448 | 24,640 |
| 76   | Stage edge illumination | Foot | 45 | 2,250 | 35 | 1,575 | - | - | - | - | 85 | 3,825 |
| 77   | Chairs (portable Folding) | Each | 300 | - | 250 | 75,000 | 250 | 75,000 | - | - | - | - | - | - | 625,000 |
| 78   | Auditorium Seating - Wood | Each | 1,200 | 480,000 | 200 | 80,000 | - | - | - | - | 1,400 | 560,000 |
| 79   | Performance Seating Portable - 12708 / 12 62 00 | Each | 400 | 480,000 | 80,000 | - | - | - | - | - | - | 560,000 |

Total: 11961 / 11 61 61 Subtotal: 184,478 / 62,132 / 84,760 / - / -

Total: 11964 / 11 61 64 Subtotal: 456,715 / 40,413 / 125,632 / - / -

Total: 12705 / 12 62 00 Subtotal: 75,000 / - / - / - / -
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Figures are in US Dollars

* Items marked with an "**" in the FFE column may be purchased outside of construction contract directly by owner.

These items are installed as part of construction work.
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<th>Recital Hall Qty</th>
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<th>Studio Theatre Qty</th>
<th>Total Qty</th>
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<th>Total Qty</th>
<th>Shops Qty</th>
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Estimated costs represent anticipated bid prices as received from specialty subcontractor if bid as of the date of this document. Estimated costs do not include: architectural, structural, mechanical or electrical systems. Escalation is not included. Taxes are not included.

Overhead, profit and contingency applied by downstream contractor(s) are also not included. (ie: We haven't included the General Contractor's O & P.)

Theatre Consultants Collaborative has no control over the cost of labor, materials or equipment, the contractor's methods of determining the bid prices, or over competitive bidding, market or negotiating conditions. Accordingly, TCC cannot and does not warrant or represent that bids or negotiated prices will not vary from any estimate of the Construction cost or evaluation prepared or agreed to by TCC.

Notes regarding items:
1) Requires CB panel with branch protection for each relay by others.
2) All items in this section installed by EC and are priced without installation (price exclusive of conduit and back box) unless otherwise noted.
3) All items in this section utilize conduit, backboxes and power distribution installed by EC and are priced without installation (price exclusive of conduit and back box) unless otherwise noted.
PERFORMANCE RIGGING & MACHINERY
STRUCTURAL LOADING ESTIMATES

Fine Arts Classroom Building
East Tennessee State University
Johnson City, TN

UPDATED 29 January, 2017

Theatre Consultants Collaborative, Inc

ADMINISTRATIVE OFFICE
6600 Manor Hill Court
Chapel Hill, NC 27516
T 919.929.7443
F 919.929.4519

ISSUED FROM
6325 Old NC 86
Chapel Hill, NC 27516
T 919.636.4533
F 877.485.7688
INTRODUCTION

This report provides detailed estimates on structural loading imposed by performance equipment and details considerations for the design of the structural system based on performance components. The report currently provides preliminary information for the primary performance spaces, and portions will be updated as required as the rooms become more defined.

Recommended criteria for the design of theater stage and rigging support systems are provided. These criteria are summarized below. It should be recognized that the given criteria represent exceptional loading conditions, above and beyond typical floor live and dead loads typically encountered in general building construction.

The information does not necessarily reflect applicable Codes, Rules and Regulations as interpreted by the state and local authorities having jurisdiction.

STAGE AND RIGGING LOADS

Performance venues are subject to unique and often severe loading conditions. These are often well above typical live and dead loads encountered in general building construction. The dynamic nature of loads, their geometry and variable nature should be understood and considered as part of the design process.

Governing Code

1. The primary model building codes of the United States, (UBC, SBCCI, BOCA, NFPA, and IBC) and local codes do not address load requirements for stage and rigging systems in sufficient detail to guide structural design.

2. Due to the high density and frequency of construction / use of rigging in New York City, it is recommended that the Building Code of The City of New York be considered to be a reasonable standard for design. A portion of these standards relating to the design of this facility is as follows:

§[C26-902.5] 27-560 Stage areas using scenery or scenic elements. - Scenery battens and suspension systems shall be designed for a load of thirty pounds per linear foot of batten length. Loft block and head block beams shall be designed to support vertical and horizontal loads corresponding to a four inch spacing of battens for the entire depth of the gridiron. Direction and magnitude of total forces shall be determined from the geometry of the rigging system including load concentrations from spot line rigging. Locking rails shall be designed for a uniform uplift of five hundred psf [sic – should read plf] with a one thousand pound concentration. Impact factor for batten design shall be seventy-five percent and for loft and head block beams shall be twenty-five per cent. A plan drawn to a scale not less than one quarter inch equals one foot shall be displayed in the stage area indicating the framing plan of the rigging loft and the design loads for all members used to support scenery or rigging. Gridirons over stages shall be designed to support a uniformly distributed live load of fifty psf in addition to the rigging loads indicated.
However, due to the size of the stage and realistic use of the facility, the rigging support steel has been de-rated to 6 inch spacing of battens. It should be noted that this still allows for future building capacity, as the current project rigging design is intended to provide 8 inch spacing.

Complete References may be found at:
http://www2.iccsafe.org/states/newyorkcity/Building/Building-Frameset.html Code Home Page

3. Impact Factors
Loads specified should be increased by impact load factors as indicated in the table below:

<table>
<thead>
<tr>
<th>Element or System</th>
<th>Impact Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Railings, channels, or battens intended for mounting theatrical lighting or scenery</td>
<td>1.75</td>
</tr>
<tr>
<td>Head block beams</td>
<td>1.25</td>
</tr>
<tr>
<td>Any system supporting running (moveable) rigging</td>
<td>1.25</td>
</tr>
</tbody>
</table>

4. Schematic Live Loading Criteria

<table>
<thead>
<tr>
<th>Element or System</th>
<th>Uniformly Distributed Load</th>
<th>Concentrated Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gridiron</td>
<td>--</td>
<td>125 psf</td>
</tr>
<tr>
<td>Loading Gallery&lt;sup&gt;1&lt;/sup&gt;</td>
<td>--</td>
<td>600 psf</td>
</tr>
<tr>
<td>Pin Rails – Uplift</td>
<td>500 psf</td>
<td>500 psf</td>
</tr>
<tr>
<td>Fly Gallery (rigging side)</td>
<td>--</td>
<td>600 psf&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Fly Gallery (non-rigging side)</td>
<td>--</td>
<td>90 psf</td>
</tr>
<tr>
<td>Locking rail – Uplift</td>
<td>500 psf</td>
<td>500 psf</td>
</tr>
<tr>
<td>Lighting Pipe Or Batten&lt;sup&gt;1&lt;/sup&gt;</td>
<td>30 psf</td>
<td>30 psf</td>
</tr>
<tr>
<td>Fire Curtain</td>
<td>900 psf&lt;sup&gt;1&lt;/sup&gt;</td>
<td>3000 lb&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Control Rooms</td>
<td>100 psf</td>
<td>100 psf</td>
</tr>
<tr>
<td>Dimmer Room</td>
<td>100 psf</td>
<td>100 psf</td>
</tr>
<tr>
<td>Follow Spot Rooms</td>
<td>100 psf</td>
<td>100 psf</td>
</tr>
<tr>
<td>Lighting Catwalks (Floor only) (Equipment, cable, accessories)</td>
<td>40 psf</td>
<td>30 plf each pipe</td>
</tr>
<tr>
<td>Loading Dock, Spaces from Loading Dock to Stage, Storage Areas</td>
<td>200 psf</td>
<td>200 psf</td>
</tr>
<tr>
<td>Stage</td>
<td>125 psf</td>
<td>125 psf</td>
</tr>
</tbody>
</table>

<sup>1</sup> Theater live loads do not include additional loads due to roof live, snow, wind, or seismic forces. Loads shown do not include required impact factors. Due to the variation in loading practices employed in performance spaces, typical loft block beam loading is represented as the greatest reaction likely in the support series and incorporates uniform and point loading reflecting equipment and applied loads. As such the loads expressed for the typical loft block beams do not sum at the head block beam.

<sup>2</sup> This concentrated load is non-concurrent with the uniform load, and can be applied in a 24”x24” square anywhere on the gridiron. “+” indicates that load may occur as uplift, or in any horizontal direction. 80% of gridiron loads suspended from the loft block beams / roof steel are non-concurrent with loft block beam loads.
3 Where loading gallery is suspended from head block beam, load is non-concurrent with head block counterweight loading for head block beam design.

4 Where fly gallery is suspended from the loading gallery above, load is non-concurrent with loading gallery.

5 As relates to the operation of equipment, live load deflection is recommended to be limited to span/360.

6 Load is distributed over the gridiron in an 18” deep area centered on and at the width of the proscenium, adjacent to the proscenium wall.

7 Load is the lateral load on the proscenium wall at the smoke pocket. Load is based on code required 2psf design criteria for pressure differential over the area of the proscenium opening (NFPA 80-2010 – 20.6.4)

5. Approximate Weight of Selected Performance Equipment

<table>
<thead>
<tr>
<th>Description</th>
<th>Footprint</th>
<th>Approx Weight in pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimmer Rack</td>
<td>26” x 34”</td>
<td>1500</td>
</tr>
<tr>
<td>Followspot - Incandescent</td>
<td>48” x 48”</td>
<td>150</td>
</tr>
<tr>
<td>Concert Grand Piano</td>
<td>3 points</td>
<td>1000-1300</td>
</tr>
<tr>
<td>Speaker Cluster point</td>
<td>Point</td>
<td>300 - 2000</td>
</tr>
<tr>
<td>Dependent on design</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RIGGING TECHNOLOGIES

Main Theatre (TL-01 – TL-10)

1. A counterweight rigging system is planned for the theatre. The system will be augmented with a few fixed speed motorized hoists for dedicated lighting pipes. Imposed loads included in this report will accommodate either technology.

2. Support beams for temporary rigging are planned at the forestage.

Blackbox Theatre

1. The Blackbox Theatre will include a tension wire grid. Loads for this are included in the QTR2XX Series drawings.

2. Support beams for aerial dance, temporary rigging, and lighting pipe battens are planned over the space, accessed from the tension wire grid. Loads are provided on the QTR2XX Series drawings.

3. The Recital Hall is planned to include lighting and access catwalks over the audience and stage.

4. A load allowance has also been provided for performance lighting fixtures over the stage platform, which will be further developed during DD.
Diagrams:

1. Structural elements and dimensions depicted in the following sketches are representational only and do not reflect engineered arrangements and elements. Actual design is the province of appropriately licensed design professionals.

2. Existing structure and configuration is based on information provided to the consultant by the architect on the date indicated, and is subject to change based on programmatic changes to the design.

3. TCC recommends providing signage on each support beam indicating capacity of beam. Signage should conform to ISO 3864-2 standard for Warning Safety Labels.
MAIN AUDITORIUM  
Applied Loading Conditions  
Upright Headblock Configuration

Structural elements and dimensions depicted in the sketches are representational only and do not reflect engineered arrangements and elements. Actual design is the province of appropriately licensed design professionals.

Loft Block Beam and Grid Well loads are non-concurrent. Grid well loads may occur within a 360° rotation about the vertical well centerline.
CATWALKS ARE SCHEMATIC. ADJUSTMENTS TO BE MADE IN PLAN AND ELEVATION TO COORDINATE ACCESS AND OPTIMIZE LIGHTING POSITIONS AND WORK AROUND ACOUSTICAL REFLECTORS.

WIDE FLANGE TROLLEY BEAMS LOCATED ON 10' CENTERS ACROSS FORESTAGE. 2000# POINT LOAD PER BEAM ANYWHERE ALONG BEAM.

PROSCENIUM THEATRE - LONGITUDINAL SECTION
EAST TENNESSEE STATE UNIVERSITY
Theatre Consultants Collaborative, Inc
www.theatrecc.com

Date: UPDATED 29 JAN 2017
Scale: 1/16" = 1'-0"
Project: ETSU-15
Reference:

Dwg: TCCjp TL-02
ALL RAILS 1.5" NOM. (1.9" OD) STEEL PIPE.

NFPA 101 REFERENCES:
- COMBUSTIBLE DECK: 12.4.5.8
- WIDTH: 12.4.5.9
- LIGHTING RAIL GUARDS: 12.2.11.1.6(1-3)
- MIN. FLOOR LOAD: 40 PSF
- MAXIMUM DEFLECTION: L/360
- LIGHTING EQUIPMENT RAILING LOAD: 30 PLF
- TOE BOARD 4” US, 125MM CANADA
ALL RAILS 1.5" NOM. (1.9" OD) STEEL PIPE.
NFPA 101 REFERENCES:
  COMBUSTIBLE DECK: 12.4.5.8
  WIDTH: 12.4.5.9
  LIGHTING RAIL GUARDS: 12.2.11.1.6(1-3)
  MIN. FLOOR LOAD: 40 PSF
  MAXIMUM DEFLECTION: L/360
  LIGHTING EQUIPMENT RAILING LOAD: 30 PLF
  TOE BOARD 4" US, 125MM CANADA

CATWALK VARIANT #2
FORESTAGE AT PROSCENIUM
Theatre Consultants Collaborative, Inc
www.theatrecc.com

Date: 1/17/15
Scale: 1/2"=1'-0"
Project: ETSU-15
Reference: TCC TL-CAT2
CATWALK VARIANT #5
ACCESS CATWALK
Theatre Consultants Collaborative, Inc
www.theatrecc.com

Date: 1/17/16
Scale: 1/2"=1'-0"
Project: ETSU-15
Reference: TL-CAT3

THIS CATWALK IS FOR ACCESS PURPOSES ONLY –
THERE IS NO PERFORMANCE EQUIPMENT FUNCTION.
DESIGN CRITERIA AS REQUIRED BY CODES &
REGULATIONS.
ALL RAILS 1.5" NOM. (1.9" OD) STEEL PIPE UNLESS NOTED OTHERWISE.
MIN. FLOOR LOAD: 600 PSF
MAXIMUM DEFLECTION: L/360
STANDARD PIPE RAILING LOAD: 30 PLF
TOE BOARD 4" US, 125MM CANADA

SEE LOADING REPORT FOR PROJECT–SPECIFIC CRITERIA
ALL RAILS 1.5" NOM. (1.9" OD) STEEL PIPE UNLESS NOTED OTHERWISE.
NFPA 101 REFERENCES:
COMBUSTIBLE DECK: 12.4.5.8
WIDTH: 12.4.5.9
RAIL GUARDS: 12.2.11.1.6(1–3)
MIN. FLOOR LOAD: 90 PSF
MAXIMUM DEFLECTION: L/350
STANDARD PIPE RAILING LOAD: 30 PLF
PIN RAIL PIPE RAILING LOAD: 500PLF VERTICAL UPLIFT AND HORIZONTAL. 1000# POINT LOAD (NON–CONCURRENT)
TOE BOARD 4" US, 125MM CANADA

FLY GALLERY CATWALK
NON-RIGGING SIDE
Theatre Consultants Collaborative, Inc www.theatrecc.com

Date: 1/17/16
Scale: 1/2"=1'-0"
Project: ETSU-15
Reference: TCC TL-FG1
PEFORMANCE EQUIPMENT
HEAT LOADING
&
ENERGY MODELING, FIRE DETECTION, FIRE SUPPRESSION SYSTEM CONSIDERATIONS

Fine Arts Classroom Building
East Tennessee State University
Johnson City, TN

2 February, 2016
INTRODUCTION

1. This report provides detailed estimates on heat loading imposed by performance equipment and details considerations for the design of fire alarm and smoke evacuation systems.

2. Loadings, sizes, dissipation, or other terms are given; these are typical only and must be checked and confirmed by the project’s Mechanical engineer for each specific equipment installation.

3. The information does not necessarily reflect applicable codes, rules and regulations as interpreted by the state and local authorities having jurisdiction.

PERFORMANCE EQUIPMENT HEAT DISSIPATION AND ENVIRONMENTAL REQUIREMENTS

1. The following table gives an estimate of the technical equipment heat output in various parts of each auditorium. Heat loads due to audience, actors, non-performance equipment and operating staff are not included.

2. To avoid serious damage to electronic control equipment and dimmers, the maximum ambient temperature may not exceed 27 degrees C (80 degrees F). It is recommended that an independent system with precise control be provided to these areas to ensure the required environment.

3. Recommendations are based on design information available at time of preparation of this document and are provided to allow design parameters and control principles for the ventilation system to be calculated.

4. Loads imposed by a Projection System are not included in this document. They are specified by others.

5. Loads imposed by the Sound, Video and Communications Systems are not included in this document. They are specified by others.

NOTES ON HEAT DISSIPATION REQUIREMENTS

1. Estimates of heat loading from performance electrical equipment predict the performance equipment use during the course of a performance. Two sets of figures are offered based on peak usage - 15 minutes and average use over the period of a performance - 3 hours. It is expected that the HVAC consultant will ensure that comfortable conditions are maintained for
the three-hour average loads but that the temperature will be allowed to rise slightly above normal limits during a 15-minute peak.

2. Show; Fifteen Minute Average
   Less than the maximum available load but an assessment of the requirement to achieve particularly bright scenes, major performance lighting effects, large orchestral setups or in periods of heavy use.

3. Show: Three Hour Average
   An average of the peak loads plus the smaller loads of more typical lighting effects, basic concert lighting, including a half hour period with only houselights in use.

4. Worklight
   The average impact of non-installed worklighting.

5. 24/7
   Load of the performance systems when they are off.

6. Performance Machinery
   This equipment is rarely used for long periods of time. Consequently, figures are only given if sustained use is expected.

7. Schematic representations of loads within the performance environment:
Typical Proscenium Theatre

Flexible (Studio) Theatre
ENERGY MODELING

1. Performing arts facilities are very different than other types of facilities in the amount of energy usage per square foot and the schedule of space usage. In this difference there is a wide range. There are two extremes in their usage patterns: Facilities that present a small quantity of events that run for long durations and ones that present many events that run for a very short duration. The former tend to have periods of intense usage followed by periods of relative quiet, the latter can be active 24 hours / 7 day a week.

2. It is important to establish a predicted activity level for this facility in conjunction with the users – they are the best qualified to predict where this space falls on the activity scale. Each performance and rehearsal space should be modeled and discussion should establish non-performance activity level anticipated in the lobby spaces.

3. It is also important to discuss how activity may differ during different seasons. For instance some facilities go dark (are unused) during the summer while others see a very intense activity level during the summer.

4. This document is a framework for discussion on where this facility falls in the event duration spectrum and suggest how energy predictions can be applied to different areas of the facility.

5. The usage of the bulk of the facility is keyed to the activity in the theatre. Activity in the theatre will be modeled in 4 blocks of time per day:
   Morning (8 am until noon),
   Afternoon (noon to 6pm),
   Evening (6pm to 11pm) and
   Overnight (11pm to 8am.)

6. Activities will be in the following categories: Performance, Lecture/Recital, Technical Rehearsal (rehearsal with lights), Technical Time (load in/load out/show maintenance), Rehearsal (in work light), Maintenance (time blocked out to maintain the facility), and Dark Days (days with no activity.)

   a. Performance is assumed to last about 2 hours
      1. The audience areas are heavily occupied and under house lighting for 45 minutes before the performance, 15 minutes of intermission and 30 minutes after the performance.
      2. The stage is in stage lighting for 2 hours at the 3 hour average level and under work lighting for 2 hours before and 1 hour after.
      3. Control rooms, rack rooms, and adjacent technical offices are fully occupied and under full load from 30 minutes prior to the performance to 30 minutes after the performance (3 hours).
      4. Wardrobe is active from 2 hours before the performance to 2 hours after the performance.
5. Dressing rooms, crew rooms, backstage lounges and green rooms are active for 1 hour before the performance and 1 hour active after the performance with half level activity during the performance.

6. The lobby is under full illumination from 1 hour before the performance to 1 hour after the performance.

7. Box office is fully active for the day up until the end of intermission.

8. Administrative areas are active from 1 hour before to 1 hour after the performance.

9. Reception, event areas in the lobby and support spaces such as catering support may be active 2 hours before the performance and 2 hours after the performance on specific nights.

b. Lecture

1. Similar activity level to Performance, except the light levels on stage are similar to the worklight draw and the house lighting may be on throughout the event.

2. Wardrobe is usually not active.

3. Dressing rooms usually have minimal occupancy.

c. Technical Rehearsal

1. Similar activity level to Performance, except the audience area is minimally occupied and the time under stage light can be up to 4 hours per block.

2. Lobby areas do not see any activity and the box office is not open for extended hours.

3. All other areas are similarly active.

d. Technical Time

1. The audience areas are in work lighting for the entire block.

2. The stage is in work lighting for the entire block.

3. Control rooms, rack rooms, and adjacent technical offices are active, but minimally occupied.

4. Wardrobe may be active.

5. Dressing rooms and green room are inactive.

6. Crew rooms and backstage lounges are active.

7. The lobby is inactive.

8. Box office has no additional activity.

9. Administrative areas have no additional activity.

10. Where technical time occurs in the overnight block it should be assumed to be 4 hours of that block.
e. Rehearsal
   1. The audience areas are in work lighting for the entire block.
   2. The stage is in work lighting for the entire block.
   3. Control rooms, rack rooms, and adjacent technical offices are inactive.
   4. Wardrobe may be active.
   5. Dressing rooms and green room are active.
   6. Crew rooms are inactive.
   7. The lobby is inactive.
   8. Box office has no additional activity.
   9. Administrative areas have no additional activity.

f. Maintenance
   1. The stage is in work lighting for the entire block.
   2. Most other areas are minimally active.

g. Dark Days
   1. Are periods of minimal activity in the theatre where worklights and cleaning lights may be on for 2 hours per block.

h. Other areas are additionally active during normal business hours 9am – 5 pm Monday through Friday include:
   1. Shops and Wardrobe
   2. All Offices
   3. Box office
   4. Rehearsal areas and rehearsal lounges
   5. Receiving areas.

**FIRE DETECTION AND SUPPRESSION**

1. There are many different types of effects used in both musical and theatrical performances. Many of these produce smoke, haze or other airborne products. Separate control zones for the stage and auditorium areas are needed for both artistic control of these effects as well as general air quality and artist and audience protection.

2. DETECTORS AND MONITORING
a. Where it is acceptable to the local Authority, providing a simple key switch that over-riding the in-duct stage and house zone smoke detectors is recommended. A visual indicator of the override condition should be provided. The key switch should have the ability to override and rearm the detectors. The over-ride system should be configured to automatically reset to full function after a period of no more than 3 hours (default reset).

b. Additionally, occasionally it may be necessary to provide a separate effects smoke removal system. In this instance the control has two buttons – one for “Prepare for Effects” which shuts off the supply and return to the stage, the dampers close to this system, and “Special Effects Exhaust” which operates an exhaust fan for a variable period of time (5-25 minutes) and then shuts it off. The normal supply/return system then turns on with 100% outside air and 100% exhaust for an adjustable period not to exceed twenty (20) minutes and then automatically returns the system to its default setting.

c. A secondary smoke removal system should have no duct detectors. Duct detectors in the stage system should be at the AHU, and not close to the stage to avoid falsing due to effects.

3. HORNS, STROBES, PULLSTATIONS AND OTHER SAFETY DEVICES

a. These should be carefully and explicitly located in conjunction with the theatre consultant to avoid their conflicting with portable and permanent equipment. In stage and house areas devices placed using the usual formulas will often be rendered non-visible by temporary equipment such as curtains.

4. SYSTEM INTERFACES

a. Often the Emergency Lighting Transfer Switch is triggered by the fire alarm system.

b. Often the sound system is muted by the fire alarm system. In some jurisdictions the system must be automatically turned off.

5. SPRINKLERS

a. These should be carefully and explicitly located in conjunction with the theatre consultant. This documentation must include the explicit routing of piping. This will avoid their conflicting with portable and permanent equipment. In stage and house areas heads placed using the usual formulas will often be subject to inadvertent damage and may render critical performance systems unusable.

6. SMOKE HATCHES / FIRE CURTAINS

a. Most local codes require the use of smoke hatches and/or smoke evacuation systems to be provided in the stagehouse and often some lobby areas. Smoke evacuation systems in the stage house should not have duct smoke detectors.
b. Fire curtain release systems should not be tied into other fire alarm systems for activation, but only for annunciation.

**PERFORMANCE EQUIPMENT HEAT LOADING ESTIMATES**

**Main Theatre:**

<table>
<thead>
<tr>
<th></th>
<th>Show: 15 Min</th>
<th>Show: 3 Hour</th>
<th>Worklight</th>
<th>Night</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat Loading in kW at FOH</td>
<td>15.46</td>
<td>6.19</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Stage</td>
<td>11.69</td>
<td>4.76</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Followspot</td>
<td>3.38</td>
<td>1.99</td>
<td>-</td>
<td></td>
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<tr>
<td>Grid</td>
<td>45.51</td>
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<td>-</td>
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<tr>
<td>Total</td>
<td>76.04</td>
<td>34.66</td>
<td>0.47</td>
<td>-</td>
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<tr>
<td>Dimmer room</td>
<td>2.18</td>
<td>2.18</td>
<td>0.38</td>
<td>0.38</td>
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</tbody>
</table>

**Recital Hall:**

<table>
<thead>
<tr>
<th></th>
<th>Show: 15 Min</th>
<th>Show: 3 Hour</th>
<th>Worklight</th>
<th>Night</th>
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</thead>
<tbody>
<tr>
<td>Heat Loading in kW at FOH</td>
<td>1.08</td>
<td>0.58</td>
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<tr>
<td>Stage</td>
<td>0.88</td>
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<td>Followspot</td>
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<td>Grid</td>
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<td>Total</td>
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<td>0.24</td>
<td></td>
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<tr>
<td>Dimmer room</td>
<td>0.26</td>
<td>0.26</td>
<td>0.26</td>
<td>0.26</td>
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</table>

**Studio Theatre:**

<table>
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<th></th>
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<th>Show: 3 Hour</th>
<th>Worklight</th>
<th>Night</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat Loading in kW at FOH</td>
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<td>-</td>
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<tr>
<td>Stage</td>
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<td>Grid</td>
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<td>Total</td>
<td>11.64</td>
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<tr>
<td>Dimmer room</td>
<td>0.26</td>
<td>0.26</td>
<td>0.26</td>
<td>0.26</td>
</tr>
</tbody>
</table>

**END OF REPORT**
PERFORMANCE EQUIPMENT
ELECTRICAL LOADING

Fine Arts Classroom Building
East Tennessee State University
Johnson City, TN

Updated 4 March, 2017
SUMMARY

1. This report provides detailed information on electrical loading imposed by performance equipment, and a schedule of estimates. It is a revised version of the original report. This version assumes a hybrid system of LED and Tungsten based stage lighting and LED house lighting in the main theatre, and LED based stage and house lighting in all other spaces.

2. Three separate electrical supplies are typically required:
   a. One servicing the dimming system.
   b. One servicing the isolated ground wiring system for Performance Sound, Video and Communications needs. Requirements for this system will be provided by others.
      i. The isolated ground supply is fed from a single isolation transformer.
   c. One serving all other loads.

3. These supplies should be split as close to the electrical service entrance as is possible.

4. Loads imposed by the Sound, Video and Communications Systems are not included in this document. They are specified by others.

INTRODUCTION

1. Buildings for performance are among the most complex of building types with regard to the design, accommodation, and installation of electrical and mechanical systems. Theatres and concert halls are often compared to hospitals as a measure of their technical complexity and sophistication. This is an appropriate comparison; however one must also keep in mind the particular geometry of performance spaces with large open areas in the lobbies, auditorium, and stage; the absence of repetitive floors; and requirements for a high level of architectural finish to appreciate the complexity of the task.

2. Performance facilities include extensive, independent, systems for architectural and performance lighting, stage machinery, audio-visual equipment, and electronic data distribution. All of these systems require electrical power for operation as well as connection to sophisticated electronic remote control devices. These systems all compete for the relatively small amount of space allocated for them. Because of the highly specialized nature of the technical equipment and performance areas, locations of control devices and conduits are of critical importance as well.

3. In order to realize the best possible building for the client, careful coordination of work by the electrical engineer (EE) and theatre consultant is essential and therefore it is important that the engineer and the consultant understand the work which is required and the role each will play in its realization.

   a. Various devices located on the plans and specified by Theatre Consultants Collaborative (TCC) will be incorporated in the engineer’s work and documents. The objective is to integrate the electrical requirements of the various performance systems into the work of the project.
electrical contractor, so that responsibility for wire ways and power supplies are under one contract.

b. Some systems may be supplied and installed by the electrical contractor. Other systems may also be supplied and installed by specialty contractors utilizing empty conduit and power feeds installed by the electrical contractor.

c. In order to achieve this integration, all of the device information supplied by TCC, with the addition of wire ways and wire size information provided by the EE, should be included in the Electrical Contract Documents.

4. TCC has developed a vocabulary that fully describes and defines the performance requirements of the various performance power and control systems. The design and realization of these systems also requires the particular engineering expertise of the EE to design the electrical installation of these systems: code compliance, size of wire and conduit for feeds, branch circuits, and controls. As theatre consultants we are not licensed to provide these engineering services.

5. TCC’s definition of the performance requirements for the various electrical systems has four components: Performance Equipment Electrical Requirements Report, General Arrangement Drawings, Box/Device Schedule, and Specifications.

a. This Performance Equipment Electrical Requirements Report outlines all of the performance equipment expected to be included in the facility. The electrical requirements for each system are described and estimated power requirements are calculated based on diversification factors from our experience and the anticipated use of the connected equipment. The Performance Equipment Electrical Requirements Report is issued during schematic design and may be reissued as required.

b. The General Arrangement Drawings use graphic symbols and a key to locate and define system components such as dimmer racks, control receptacles, and performance lighting device receptacles on the Architect’s plan. All of the symbols are numbered and keyed to a Box/Device Schedule that provides additional data on each component, such as number and ampacity of branch circuits, mounting heights, finish requirements, etc. This will be issued during design development.

c. TCC will also provide Specifications for all performance equipment technical systems that are within our contract scope. Typically, several of these systems will be provided by the electrical contractor. In this case, specifications prepared by TCC will be provided to the EE for review and inclusion in the Electrical Contract Documents.

6. The process which has worked most effectively in the past for producing coordinated Electrical Contract Documents for performance equipment is for the EE to assume “ownership” of TCC symbols and schedules, placing them on the electrical drawings during the preparation of Contract Documents and providing additional information for the electrical contractor regarding wire size, conduit, etc.
PERFORMANCE ELECTRICAL SYSTEMS OVERVIEW

1. Performance Lighting
   a. Performance Lighting is a system of SCR dimmers, motorized breakers, relays, control and data devices, and receptacles located throughout the performance facility for the connection of portable stage lighting fixtures.
   b. TCC will specify the SCR dimmers, motorized breakers, relays, and control equipment as well as all of the specialty distribution. This means selecting and specifying equipment (Section 11961 / 11 61 61), locating equipment on General Arrangements drawings, preparing faceplate detail drawings, schedules, and risers for equipment. We will also provide a coordination document for the EE's use (Section 16580 / 26 09 61.1).

2. House Lighting
   a. House Lighting (audience and architectural lighting in the auditorium) will be designed by the architect, EE or architectural lighting designer.
   b. House Lighting fixtures will be circuited and scheduled by the EE.
   c. Where house lights are LED based TCC will
      1. Specify the control system and coordinate with the EE on the design of the control infrastructure.
      2. Make recommendations of fixtures that have worked well in the past for consideration by the EE or architectural lighting designer.
      3. Where they are used for Emergency illumination TCC will specify a dedicated DMX control riser with a DMX Emergency Bypass Controller to tell the emergency fixtures to turn on to full when emergency power is provided.
   d. TCC will specify House Lighting power and controls to accommodate the House Lighting schedule supplied by the electrical engineer or architectural lighting designer.
   e. Where ASHRAE 90-1 2013 applies the team must answer some questions on how to interpret the directives therein.
      1. If there is a Balcony is it a separate room for the area calculations.
      2. Partially illuminating per the zoning requirements would seem to create a trip hazard (stairs and ramps). Does this qualify as an exception under 9.4.1.1[a]?
      3. If the zoning requirement is exempted does the architectural control system with variable illumination level at the main consoles satisfy the bi-level control requirements?

3. Work Lighting
   a. Work Lighting includes fixtures used to illuminate the stage and its support areas during performance and non-performance periods.
   b. Some Work Lighting fixtures may be portable, plug-in units included in the Performance Fixture package specified by TCC, or specified by the electrical engineer.
c. Other Work Lighting fixtures will be permanent, architectural lighting fixtures. TCC will provide design criteria or recommendations for fixed work lighting fixtures. These will be designed, circuited, scheduled, and specified by the electrical engineer.

d. TCC will specify motorized breakers, and controls for Work Lighting. The EE must supply a schedule of permanent, work light circuits that includes control channel, source type (Incandescent, fluorescent, short arc, etc.), and load for accommodation in the dimming and control systems specified by TCC.

e. Where ASHRAE 90-1 2013 applies the team must decide what type of space is similar. There is no clear answer and none of the choices are in any way similar.

4. Emergency Power / Lighting

a. Transfer of lighting loads to emergency power is best accomplished downstream of the performance dimming and relay control systems. Later in this report manufacturer’s data on commercially available Branch Circuit Automatic Transfer Switches that comply with applicable code requirements will be provided.

b. Feeding dimming systems and relay control system with emergency (or alternative) power is not recommended because they are not certified life safety devices.

c. TCC will specify UL924 Emergency DMX bypass devices where applicable for use with DMX-controlled LED emergency lighting.

d. The EE and architectural lighting designer have full responsibility for the design of emergency lighting systems to meet code requirements.

5. Performance Machinery

a. The project may include elements of performance machinery specified by TCC that require electrical accommodation designed and specified by the EE. Such machinery might include motorized rigging, motorized systems for adjusting room acoustics, and lifts.

b. Touring disconnects for performance machinery may require an isolated ground. When required this should be separate from the Sound System Isolated ground. See schedule.

c. Engineer’s responsibilities include:
   1. Junction boxes and empty conduit for power and control systems.
   2. Electrical power distribution with disconnect switches at equipment locations.
   3. TCC will specify the Performance Machinery. This means selecting and specifying equipment (Section 11060 – 11069, 11112, 11185 & 11941 / 11 61 00, 11 61 13, 11 61 30 - 11 61 39, 11 61 43 – 11 61 44, and 11 61 55), locating equipment on General Arrangements drawings, preparing faceplate detail drawings, schedules, and risers for equipment. We will also provide a coordination document for the EE’s use (Section 16584 / 26 09 61.4) and a document to carry the schedules into CD (Section 16581 / 26 06 61).
PERFORMANCE EQUIPMENT ELECTRICAL SYSTEM REQUIREMENTS

1. General
   a. Branch circuit protection devices for all performance locations must be easily accessible to performance personnel. Panel boards for receptacles and equipment on the stage must be located on or immediately adjacent to the stage. Panel boards for followspots and rear-of-house receptacles must be located in the followspot or lighting control room.

2. Performance Lighting Power Control Systems
   a. Centralized dimming may, or may not be used depending on the needs of the house lighting.

   b. In a system that is primarily LED based there will be no performance lighting loads on the centralized dimming system. Stage lighting will be fed from a combination of motorized breaker panels and busway.

   c. The performance power and control equipment will consist of dimmer racks, motorized breaker panels and relay cabinets, control wiring and devices, and branch circuit wiring, distribution, and connection devices. The electrical supply and distribution system must be designed to meet the following criteria:
      1. Dimming/Motorized Breaker/Relay System Supply: 208Y/120
      2. Branch dimmed circuits: All 2-wire + Ground (no shared neutrals). Receptacle rating as per schedule.
      3. Voltage at Performance Lighting Receptacles under full load conditions: 115-120 VAC.

   d. Several factors will influence the design of an efficient electrical supply and distribution system:
      1. NEC Article 520
      2. The type of dimmer:
         a. Standard dimming systems dim by vertically cutting the wave form. These SCR and IGBT (forward phase and reverse phase) dimming systems produce distorted waveforms due to extremely non-linear currents drawn by the dimmers. This electrical interference can affect electronic control devices, computers, modems, etc.
         b. Pulse Width Modulation (for LED) dimming makes each fixture appear similar to a desktop computer in terms of impact on the power system.
      3. Branch circuit runs are often extremely long in performance buildings.
      4. The insertion loss of the dimmers:
         a. Standard dimmers: 3% to 7%, depending on the rise time of the dimmer.
      5. Terminal loads will be:
         a. Incandescent loads with centralized SCR dimmers.
         b. Incandescent loads with local SCR dimming.
         c. LEDs with 0-10v low-voltage dimming
         d. LEDs with local pulse width modulated dimming
      6. Systems with large amounts of LED circuits will have few or no centralized dimmers. In this case distribution will be via a combination of 100A – 400A Busduct switched via a high amperage multipole switch and 20A – 30A Motorized Breakers.
e. Inrush Current

1. LED loads have high inrush currents and these light sources are anticipated to be a growing portion of the light sources on stage, therefore supplies feeding lighting loads require breakers capable of tolerating high inrush currents.

g. Power Feeds

1. A high impedance supply is desirable to minimize filament ring.

2. A separate Delta-Wye transformer dedicated to the dimmer racks is desirable as a means of containing the harmonics in systems with large amounts of SCR based dimming.

3. Standard Dimmers:

a. Standard dimmers present a non-linear load. A K rated or HMT transformer is recommended for use on a dimming system because of this non-linear load. As the nature of the harmonics are difficult to characterize in a lighting system an empirical selection of the transformer has led industry experts to recommend a K-13 rating or a HMT. Using the either type transformer will also have the bonus effect of extending the life of the transformer and reducing the operating temperature of the transformer.

b. At some stage of dimming, neutral current can exceed phase current, as high as 140%, of phase current on three phase systems, although these currents are normally less than the full-on current. Because of the harmonics generated by high speed SCR power switching supply neutral conductors must be oversized due to excess current in the neutral. Refer to code for requirements.

c. **DO NOT USE HARMONIC FILTRATION.** Experience has shown that blocking the harmonics causes wave form distortion including false zero crossings. SCR dimmers rely on relatively clean wave forms. Using a harmonic filter will cause flashing, flickering and equipment failure.

4. Performance lighting load may go from nil to full listed load in one second.
5. Due to the nature of the SCR dimmer load, ground fault interrupt breakers will trip falsely. For this reason they are inappropriate for lighting loads. We recommend using electronic-trip circuit breakers listed for operation at 100% of their rated load.

6. Because of the restrictive voltage drop allowance, long branch circuit runs, and the insertion loss of the dimmers, the dimming system power must often be supplied at an elevated voltage. The Dimmer Racks should be located as close as possible to the branch circuits supplied. In a large installation it may be cost-effective to locate the dimmer racks in multiple locations (multiple dimmer rooms) within the facility in order to minimize the lengths of branch circuit runs.

7. UL requires wire to be 90˚ C. copper only.

8. NEC 520.27 tells us to size the feeder capacity to match the load. The table at the end of this document addresses this predicted load.

h. Branch Wiring

1. Details of branch wiring for the Performance Lighting Dimmers and Faceplates to be provided under the general contract will be provided in the Electrical General Arrangement Drawings prepared by TCC during Design Development phase.

2. A quantity and capacity of branch circuits may be provided to assist the EE in preparing early cost estimates. These figures will change during the design process, but the diversified total use figure will remain constant.

3. Branch protection of these circuits will be provided as part of the Performance Dimmer equipment. The circuit breakers on the dimmers are listed for use at 100% of their rated load on a 100% duty cycle.

4. Although there is a large diversity of total load, each branch circuit must accommodate its full-specified load with minimal line loss. Studies have shown that in a group of cables a 50% overall derating is realistic design criteria.
   a. In Table B.310.11 (Nec 2008) is code to accommodate this condition.

5. Note that NEC provides an exception to the limitation on the absolute number of conductors in a wireway in 520.6 (Nec 2008).

6. Most of the performance lighting receptacles have terminal blocks to speed installation. These are typically NEMA 1 enclosures. The terminal blocks have the following wire capacities:
   a. 10Amp-20A: #8-#14 AWG
   b. 50A: #4-#10 AWG
   c. 100A: #2/0-#8 AWG

7. House lights are usually fed by a group of 2.4kw dimmers. On occasion it may be desirable to use a 6kW dimmer in which case one or more outboard breaker panels may be necessary to provide branch protection for the branch circuits on the house lighting dimmers.

8. Neutrals
   a. Dimmed circuits must have a dedicated neutral per circuit and that neutral must travel to the rack in the same conduit as its hot.
   b. SCR Dimmers
      1. Shared neutrals are not allowed in SCR dimmers because of harmonics and elevated neutral currents in a shared neutral arrangement.
      2. In an SCR circuit or a switched circuit with a high amperage switching power supply, or a system with mixed SCR and sinewave modules the
neutral is considered a current carrying conductor per most electrical codes.

9. NEC 520.44 addresses flexible cable feeding borderlights, connector strips and drop boxes.

10. Connector strips and 6 circuit multidrops mounted in the rigging system are fed by flexible cable from grid iron junction boxes which are in turn fed by the dimmer racks and relay panels. These multicable lengths are sufficient to reach from the grid iron junction box to the stage floor. Multicable is either #12 Stranded or #10 stranded. The EE should indicate which is required to meet the electrical system design criteria.

11. 6 Circuit multicable distribution with Litton-VEAM VSC Series compatible tails mounted in the rigging system are fed by flexible cable from grid iron junction boxes which are in turn fed by the dimmer racks and relay panels. While the grid iron junction boxes are provided by the Performance Lighting Contractor the flexible multicable is provided by the Electrical Contractor and must be sized by the EE. The multicable lengths must be verified on site as position of the multiconductor box and travel of the rigging system effect required cable length.

a. This installed multicable is constantly subjected to bending as pipes are raised and lowered, consequently the cable must be designed for “extra-hard usage”.

b. The Electrical Contractor should also supply cable cradles, cable clamps (for the rigging contractor to use to suspend the cable) and strain relief devices for each cable. (Note that these must be sized for the specific cable used.) Each multicable typically requires:
   1. One “box type” strain relief at the junction box.
   2. One “support type” eye strain relief where the cable is dropped from the area where the junction box is.
   3. One cable cradle at the cable mid-point.
   4. One “support type” eye strain relief prior to the multiconnector.
   5. One multiconnector with strain relief (supplied by the performance lighting contractor, installed by the electrical contractor.)

c. Suppliers of multiconductor cable to the entertainment industry:
   1. TMB - Procable
      Englewood, NJ  201-541-9292  www.tmb.com
   2. SSRC - Multi-conductor cable
      Greer, SC  864-848-9770 www.ssrconline.com
   3. Coast Wire & Plastic Tech, Inc
      Carson, CA  800-514-9473  www.coastwire.com

i. A transformer dedicated to the dimming system and Company Switch supplies can be tapped to provide an elevated supply voltage and will help to isolate the dimming system’s distorted waveforms. The transformer can be efficiently located adjacent to the dimmer racks, minimizing the lengths of 208Y/120 feeders required. Because the transformer will likely be located adjacent to the performance space, the acoustician may require that the transformer be acoustically isolated by means of a floating slab, flexible conduit connections, and other noise attenuation techniques.

3. Worklight/Distributed Dimming Lighting System

a. Worklight circuits and non-dim lighting will be remotely switched using motorized breaker panels specified by the Theatre Consultant.

   1. The cabinets available include:
      a. Benjamin Electric motorized breaker panel
b. Lyntec RPC Series
   This is a Square D motorized breaker panel with custom electronics in a control side car. These employ ECB-G3 breakers.

2. Factory prewired assemblies of standard breaker panels and relay panels will be allowed as an alternate.
   a. Electronic Theatre Controls
   b. SSRC
   c. Intelligent Lighting Controls
   d. Pathway
   e. Siemens
   f. Wattstopper.

b. Non-dim lighting circuits will be used for temporary equipment. Like dimmed circuits these will terminate in performance lighting faceplates, require fully rated 20a circuit breakers designed for a continuous peak load, require a dedicated neutral and require wiring rated at a full 20 amps.

4. Emergency Light Transfer Switch (ELTS)
   a. Code requires that a number of house lighting circuits be automatically placed on emergency power in the event of a failure. The most desirable way to accomplish this is with one Emergency Light Transfer Switch for each performance space. This emergency transfer switch must be able to reroute the hot and neutral from normal power to emergency power for selected individual circuits. These will be specified by the Theatre Consultant based on circuit requirements and supply feeds required by the EE.

b. ELTS devices may be furnished with a feed per circuit, known as discrete fed or with a main feed that may be single phase or 3 phase. Main fed ELTS devices have integral branch protection using 20 a circuit breakers which are not fully rated; therefore loads should be limited to 80% of the breaker rating.

c. The primary suppliers for these devices are
   1. Electronic Theatre Controls, Inc, 3030 Laura Lane, Middleton, WI  53562 - Model ELTS (additional codes are appended to indicate number of poles and ampacity.)
   2. Union Connector, Inc., P.O. Box 507, Roosevelt, NY  11575; 516-623-7461 - Model UC700 (additional codes are appended to indicate number of poles and ampacity.)
   3. Stagecraft Industries, Inc.   P.O. Box 4442, Portland, OR 97208 - 503-286-1600 - Model UL1008

d. Sometimes, up to 2 remote switches will be provided for each performance space to allow elective operation of the transfer switch and to indicate system status.

5. Emergency DMX Bypass Devices
   a. Code requires that a number of house lighting circuits be automatically placed on emergency power in the event of a failure. If these house lighting circuits are DMX controlled, the DMX data for each fixture must be driven to full in in order for the fixture to illuminate. To achieve this, an Emergency DMX Bypass Device or devices is required for each performance space. These devices will be specified by the Theatre Consultant based on circuit requirements, fixture types, and supply feeds required by the EE.
b. The primary supplier for these devices is:
   1. Electronic Theatre Controls, Inc, 3030 Laura Lane, Middleton, WI 53562 - Model ELTS
      (additional codes are appended to indicate number of poles and ampacity.)

6. Performance Equipment Switchboards
   a. Switchboards are required to supply power to various items of performance equipment.
   b. Input sizes are estimated maximum demand excluding starting loads.
   c. Loads are given in kW. Motor sizes are given in KW on the simplified assumption that 1 Horsepower requires 1 kW.

7. Touring and Portable Equipment Disconnects (Company Switches, Disconnects, Buss Duct)
   a. A Company Switch is a power disconnect that is used for temporary performance equipment rated for frequent connections and disconnections. A project may include several Company Switches in various locations for specific requirements. TCC will provide the location, system voltage, and ampacity of each Company Switch. The Theatre Consultant will specify the switches. The EE must specify the installation of each switch, design its supply, and provide adequate fault current protection.
   b. For temporary connections Standard dimmers (as opposed to Sine Wave) should be assumed and as a consequence it should be assumed that there will be a full load, imbalanced SCR load, with all the harmonics that implies.
   c. Reference Article 520-51 of the 2008 NEC.
   d. All Company Switches require a suitable cable connection chamber with Buss-Bars to enable termination of bare cable ends to lugs. Most disconnects will require single-pole separable connectors, such as the Cam-lock J Series (or compatible as approved by TCC), in addition to the cable connection chamber. The Cam-lock connector is the industry standard power connector.
   e. Company Switches intended to supply temporary dimming equipment may be supplied at the same elevated voltage as the installed dimming system since both systems have similar characteristics.
   f. The equipment should include pilot lamps indicating presence of power on each phase and may include a voltmeter for monitoring phase voltage on any phase.
   g. Proprietary products are available to provide both the cable connection chamber and cam-lock connection facility required of the Company Switch. The primary suppliers for these devices are:
      1. Union Connector, Inc., P.O. Box 507, Roosevelt, NY 11575; 516-623-7461 - Series #50-PBS-MxxxxW-C/SP (xxxx is replaced with amperage and neutral code)
      2. SSRC, Inc 2172-A River Rd., Greer, SC 29650-4504 - DS-XXX-YW-C (xxx is replaced with amperage and Y is replaced with a 6 for a 400 amp disconnect or 5 for a 200 amp disconnect indicating the number of connectors)
      3. Lex Products, Inc 401 Shippan Ave, Stamford, CT 06902 - DBM XXX-CS001 (xxx is replaced with amperage) - Note that the 400A version requires the 2 nd neutral option.
h. Disconnects are required to power various items of equipment on a temporary basis. All disconnects require a suitable cable connection chamber with Buss-Bars to enable termination of cable ends and lugs.

8. Busduct

a. Certain panel boards will require Busduct wire way. Busduct refers to Universal Electric Corporation Starline Busway or equivalent. This type of busduct is specified because it is rated for connection / disconnection of taps while energized. 100A Busway would be their B100A series.

b. Where extensive quantities of busduct are employed for Performance Lighting they will be switched via a high amperage multipole switch that is furnished by the performance lighting contractor as and accessory to the motorized breaker panel.

c. Busways will support loads with high inrush currents which include motor loads and LED lighting fixtures. Breakers should be selected accordingly. We typically see breakers that have a D-Curve (10xrated current, minimum.)

d. Power for distributed via a series of bustaps with specialized connectors.

9. Fault Current Protection

a. Dimming Systems - Commercially produced performance dimming systems typically have an AIC short circuit rating of 100,000 RMS symmetrical amperes. Either the short circuit let through must be reduced below the 100,000 amperes withstand rating of the equipment or the dimming systems must be specified and supplied with custom modification to increase the system withstand rating.

b. Company Switches - As above, the temporary equipment connected to these disconnects will typically have an AIC short circuit rating of 100,000 RMS symmetrical amperes. Since the withstand rating of the temporary equipment is out of the control of the specifier, the Company Switch must have adequate fault current withstand ratings.

c. Busway Bustaps - The temporary equipment connected to these disconnects will typically have an AIC short circuit rating of 22,000 RMS symmetrical amperes.

10. Temporary Cable Management

a. The installation of temporary performance equipment often requires the installation of temporary cabling. The cable management system includes capped and sleeved openings through walls and floors, empty cable trays, and cable hooks for the routing of temporary cabling throughout the performance facility.

b. TCC will provide locations of penetrations and routing of cable tray and hooks to the EE and Architect for inclusion in the Contract Drawings. It is generally financially advantageous for these to be provided by the general contractor.

11. Other Special Requirements

a. NEC 520 has many requirements specific to theatres. It would be very important for the engineer to become familiar with this section.
b. One particularly impactful requirement (NEC 520.5) relates to encasing non-metallic conduit in concrete.

c. NEC has specific requirements regarding the wiring of power, and the enclosure of lights in dressing rooms. Refer to NEC 520.70-72 for details.
   1. These requirements include providing an indicator light in the hallway outside the dressing room that shows the energization state of the switched receptacles above the counters (usually one circuit per station). We recommend providing signage next to this indicator informing the user of what it is indicating.
   2. The requirement to cage the lamps seems to be vestigial in the case of LED based illuminators.

d. ASHRAE 90-1 2013 requires that dressing rooms have occupancy sensing, daylight sensing if they have windows and bi-level controls. With regard to the bi-level controls it needs to be determined if the general illumination would satisfy the ½ level with the mirror lights satisfying the full illumination, or if the general illumination needs to be bi-level.
   1. Recommended fixtures:
      a. Targetti North America Lite-Bar 100 series with Wire Guard option
      b. Cole Lighting VS-WG series

12. Architectural Lighting

   a. Aisle Lighting
      1. In general it is preferred aisle lighting to come from the seat standards.
      2. Aisle lighting from seat standards require a junction box to be cast into the concrete. There is a junction box designed for this purpose: Hubbell part number F3185
      3. Where aisle lighting is from walls it is preferable to locate wall mounted fixtures so they are not in seated audience member's line of sight. For similar reasons we want fixtures that have a 90 degree cutoff, are black, a clear lens, and have no visible reflector.
      4. Fixtures that people have used to fulfill these needs:
         a. Tivoli's Fantasma Seat Light www.tivolilighting.com
         b. ioLighting's Plane Step Light: www.iolighting.com
         c. Kenall's MSL Series SoftStep fixture: www.kenall.com
         d. Lumux's SL632
         e. BEGA's 2219P w/Micro-louver
         f. MP Lighting L13
         g. Belfer 3430FP or 3441FP

   b. Running Lights
      1. For these we generally look for the same attributes as the wall mounted aisle lights, only with blue light.
      2. Most typically, these are a Blue LED fixture mounted to a single gang backbox. Low voltage and mains-dimmable fixtures are available, though low-voltage are often preferred for zoning purposes.
      3. Fixtures that have been used to fulfill these needs:
         a. GDS by ETC Blues fixture with eyelids, cowels, and accessories (LV or Mains).
         b. BEGA's 2219P w/Micro-louver with blue filter.
c. **MP Lighting L13 with blue LED.**

d. **Belfer 3430FP or 3441FP with blue filter.**

c. **House Lights**

1. These must be smoothly dimmable over their entire range. As a consequence we generally see halogen lamps or LED based fixtures. We have yet to find a fluorescent fixture that does not flash on and flicker off.

2. **LED Fixtures:**
   a. If LED fixtures are contemplated they must be fully dimmable. An LED fixture that does not have a separate control circuit is most likely not fully dimmable. Question any claims made by manufacturers to the contrary.
   b. There is no dimming standard for LED architectural lighting fixtures. As a consequence early coordination in design and continued coordination during contract administration is critical to having a functioning system.

3. **House Lights with lamp lives under 20,000 hours must be located to enable relamping without the use of a scaffold.**

4. If low voltage fixtures are to be used these must be carefully coordinated with the dimming system to ensure compatibility.

5. **Self dimming fixtures should dim down to <=0.1%.**

6. **Self dimming fixtures with DMX control are preferred. Should the engineer desire to use these fixtures for emergency lighting a UL 924 rated DMX control signal transfer switch is now available.**

7. **Configurable via wireless interface via DMX/RDM is preferred.**

8. **Self dimming 0-10v fixtures are an option but the Electrical Engineer must verify that the fixture driver is compatible with sinking control, has a secondary Class 2 dimming circuit and is compliant with ANSI C82.11c Low Voltage Control Interfaces for Controllable Ballasts. Non-compliant fixtures can cause thousands of dollars of damage to the control system.**

9. Be mindful of the power factor on LED fixtures. We have found some with a power factor of .5 when on full.

10. **LED Fixtures that have been used to fulfill these needs:**
    a. **GDS by ETC ArcSystem -** [https://www.etcconnect.com/Products/Lighting-Fixtures/ArcSystem/](https://www.etcconnect.com/Products/Lighting-Fixtures/ArcSystem/) - Uses an ARC Mesh control protocol, which doesn’t require data wires to each fixture. Fixtures are also UL924 listed for emergency use.
    b. **The Light Source 100 Watt House Light**

d. **Cleaning Lights**

1. Often it is most economical operationally to provide instant start high efficiency fixtures for cleaning in the audience seating area. These are often also used as emergency lights as they have a significantly lower power consumption.

2. May be the same fixture system as house lights if LEDs are to be used.
3. Typically these are highbay fluorescent lamps, LED, or induction lamps.

e. Emergency Light

1. Battery Packs
   If you opt for battery packs make sure any battery packs in the stage and audience environment do not automatically test themselves at any interval. The users cannot tolerate an emergency light coming on at random times.

### SUMMARY OF DIVISION OF WORK

1. The following is a summary of the typical Division of Work. The EE should establish the principles for the Division of Work with the Theatre Consultant prior to commencement of design drawings.

2. Performance Rigging Equipment:

   a. Low voltage wire and cable is provided by Performance Machinery (PMC) contractor.

   b. Wire and cable carrying more than 100V provided by Electrical Contractor including all terminations.

   c. Power from the breakers and/or disconnects to the equipment is provided by Electrical Contractor and terminated in the equipment racks and panels by Electrical Contractor at devices provided by PMC contractor.

   d. Power wiring within the equipment racks and panels is provided by PMC contractor.

   e. Back boxes are provided by Electrical Contractor contractor unless otherwise noted.

   f. Conduit with pull lines are provided by Electrical Contractor.

   g. Faceplates are provided by PMC contractor.

   h. Conduit and boxes with floor and wall penetrations are indicated in this schedule and on the drawings. Additional conduit, wire, and junction boxes will be required by the PMC contractor for an operable system, and should be coordinated by the Electrical Contractor.

3. Performance Lighting:

   a. Control wire and cable is provided by Performance Lighting Control (PLC) contractor.

   b. Wire and cable carrying more than 100V provided by Electrical Contractor including all terminations.

   c. Power from the breakers to the electronics racks is provided by Electrical Contractor and terminated in the electronics racks by PLC contractor.

   d. Power in the electronics racks is provided by PLC contractor.
e. Dimmer racks, relay panels, motorized breaker panels, company switches, busduct, bustaps, and remotely controlled high amperage multipole switches are supplied by PLC and installed by Electrical Contractor.

f. Back boxes are supplied by PLC contractor unless otherwise noted, except of "Gang" boxes which are supplied by the Electrical Contractor. All back boxes are installed by the Electrical Contractor.

g. Conduit with pull lines is provided by Electrical Contractor.

h. Control faceplates are provided by PLC contractor. Faceplates with terminations above 100V are supplied by PLC contractor to Electrical Contractor for installation by Electrical Contractor.

4. Performance Machinery:
   a. Low voltage wire and cable is provided by Performance Machinery (PMC) contractor.
   b. Wire and cable carrying more than 100V provided by Electrical Contractor including all terminations.
   c. Power from the breakers and/or disconnects to the equipment is provided by Electrical Contractor and terminated in the equipment racks and panels by Electrical Contractor at devices provided by PMC contractor.
   d. Power wiring within the equipment racks and panels is provided by PMC contractor.
   e. Back boxes are provided by Electrical Contractor unless otherwise noted.
   f. Conduit with pull lines are provided by Electrical Contractor.
   g. Faceplates are provided by PMC contractor.
   h. Conduit and boxes with floor and wall penetrations are indicated in this schedule and on the drawings. Additional conduit, wire, and junction boxes will be required by the PMC contractor for an operable system, and should be coordinated by the Electrical Contractor.

PERFORMANCE EQUIPMENT ELECTRICAL LOADING ESTIMATES

1. This section provides detailed requirements for electrical supplies for each area, estimated numbers of branch circuits, and estimates of electrical loading imposed by performance equipment. As stated earlier, TCC will provide General Arrangement drawings indicating the locations of the anticipated loads and devices later in the design process, during the Design Development phase.

2. The figures in these reports do not include requirements related to telephone, data, or cable television; these are specified by others.

3. Loadings, sizes, or other terms are typical only and must be checked and confirmed by the project’s EE for each specific equipment installation.
4. The information does not necessarily reflect applicable Codes, Rules and Regulations as interpreted by the state and local authorities having jurisdiction. Code compliance remains the responsibility of the Architect and EE.

5. Loads are given in KW. Motor sizes are given in HP on the simplified assumption that 1 Horsepower requires 1KW.

6. Equipment locations requiring Isolated Ground or Isolated Power electrical supplies are designated.

7. The supply sizes include a diversity allowance typical of the nature and use of the intended loads.

8. Information is based on the design information available at time of preparation of this report and is provided to allow general power and distribution requirements to be planned.

**PERFORMANCE EQUIPMENT ELECTRICAL REQUIREMENTS SCHEDULE**

(See attached)
<table>
<thead>
<tr>
<th>Location</th>
<th>Load Type</th>
<th>Termination</th>
<th>Qty Circuits</th>
<th>Amps</th>
<th>Single Phase Voltage</th>
<th>120V Demand</th>
<th>Transformer Demand KW</th>
<th>Transformer Demand %</th>
<th>Notes</th>
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<td>Dimmer Room</td>
<td>Theatre - SCR Dimmers</td>
<td>Dimmer Rack</td>
<td>1</td>
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<td>144</td>
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<td>Automated Fixtures / Worklights / LED</td>
<td>Motorized Breaker Panel Board</td>
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<td>200</td>
<td>120</td>
<td>72</td>
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<td>Automated Fixtures / Worklights / LED /Portable Relay</td>
<td>Busduct</td>
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<td>4</td>
<td>100</td>
<td>120</td>
<td>108</td>
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<td>Grid</td>
<td>Automated Fixtures / Worklights / LED /Portable Relay</td>
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<td>Automated Fixtures / Worklights / LED</td>
<td>Multipole Switch</td>
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<td>Multipole Switch</td>
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<td>Portable Stage Lighting Fixtures</td>
<td>Perf Lighting Faceplate</td>
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(1) Rack Fed MLO at 400A. See Performance Lighting Faceplate (below) for branch distribution. Based on hybrid system of Conventional and LED Performance Fixtures.

Performance, House, and Work Lighting. See Performance Lighting Faceplate (below) for branch distribution.

Fed from Multipole Switch to feed localized dimming circuits and portable relays.

Fed from Multipole Switch to feed localized dimming circuits and portable relays.

See Performance Lighting Faceplate (below) for branch distribution.

See Performance Lighting Faceplate (below) for branch distribution.

Receptacles typically represent 20A distribution from dimmers in clusters of 6, on the average. Load specified at the dimmers. Average Length 100’. Conduit and wire size by others.

Average Length 120’ Conduit Size 1” metallic
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<th>Revision</th>
<th>Supply</th>
<th>Space</th>
<th>Location</th>
<th>Load Type</th>
<th>Termination</th>
<th>Dry Circuits</th>
<th>Dry Terminations</th>
<th>Amps</th>
<th>Phase</th>
<th>Single Phase Voltage</th>
<th>Item Total</th>
<th>Div %</th>
<th>Demand kW</th>
<th>Group Div %</th>
<th>Transformer Div %</th>
<th>Transformer Demand KW</th>
<th>Space Demand KW</th>
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<td>Company Switch</td>
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<td>P-9</td>
<td>Follow Spot</td>
<td>Follow spots, etc.</td>
<td>Receptacle</td>
<td>6</td>
<td>6</td>
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<tr>
<td>P-10</td>
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<td>Follow spots, etc.</td>
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<td>1</td>
<td>100</td>
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<td>120</td>
<td>36</td>
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<td>Diversified total: 63%</td>
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</table>

### Schedule - Studio Theatre

#### Lighting Group

<p>| | | | | | | |</p>
<table>
<thead>
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</thead>
<tbody>
<tr>
<td>P-35</td>
<td>Dimmer Room</td>
<td>Automated Fixtures / Worklights / LED</td>
<td>Motorized Breaker Panel Board</td>
<td>1</td>
<td>1</td>
<td>200</td>
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<tr>
<td>P-36</td>
<td>Tension Grid</td>
<td>Automated Fixtures / Worklights / LED /Portable Relay</td>
<td>Busduct</td>
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<td>1</td>
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</table>

See Performance Lighting Faceplate (below) for branch distribution.

Fed from Multipole Switch to feed localized dimming circuits and portable relays.
<table>
<thead>
<tr>
<th>Notes</th>
<th>Design</th>
<th>Load Type</th>
<th>Supply Location</th>
<th>Space</th>
<th>Circuit</th>
<th>Terminations</th>
<th>Demand kW</th>
<th>Group Demand kW</th>
<th>Transformer Demand kW</th>
<th>Transformer Div. %</th>
<th>Group Div. %</th>
<th>Transformer Div. %</th>
<th>Group Div. %</th>
<th>Load Type</th>
<th>Supply Location</th>
<th>Space</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Automated Fixtures / Worklights / LED</td>
<td>P-37 Dimmer Room</td>
<td>P-37</td>
<td>36 100 1 120 72 40</td>
<td>1 1 1 15 1</td>
<td>72% 50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
<td>18</td>
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<td></td>
<td></td>
<td>Portable Stage Lighting Fixtures</td>
<td>P-38 Theatre</td>
<td>P-38</td>
<td>72 Low Voltage Conduit</td>
<td>1 1 1 200 1 15 1 120 30 (conduit)</td>
<td>72% 50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
<td>18</td>
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<tr>
<td></td>
<td></td>
<td>Park Lighting Controls</td>
<td>P-39 Theatre</td>
<td>P-39</td>
<td>72 Company Switch</td>
<td>1 1 1 200 3 15 1 120 3</td>
<td>72% 50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
<td>18</td>
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<tr>
<td></td>
<td></td>
<td>Touring Disconnects, etc.</td>
<td>P-40 Theatre</td>
<td>P-40</td>
<td>72 Circuit Breaker Panel</td>
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<td>72% 50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
<td>18</td>
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<td>Parking lot / EBW</td>
<td>P-41 Dimmer Room</td>
<td>P-41</td>
<td>120</td>
<td>1 1 1 15 1 120 3</td>
<td>72% 50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
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<td>18</td>
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<td>Emergency Lighting</td>
<td>P-42 Dimmer Room</td>
<td>P-42</td>
<td>120 ELTS Cabinet</td>
<td>1 1 1 60 3 15 1 120 3</td>
<td>72% 50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
<td>18</td>
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<td></td>
<td></td>
<td>Emergency Lighting Transformer</td>
<td>P-43 Control Booth</td>
<td>P-43</td>
<td>120 Computer</td>
<td>1 1 1 60 3 15 1 120 3</td>
<td>72% 50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
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<td>36</td>
<td>50%</td>
<td>18</td>
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<td></td>
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<td>General Service</td>
<td>P-44 General Group</td>
<td>P-44</td>
<td>16 20 1 120 7 50%</td>
<td>1 1 1 50 2 15 1 120 3</td>
<td>72% 50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
<td>18</td>
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<tr>
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<td></td>
<td>General Service</td>
<td>P-45 General Group</td>
<td>P-45</td>
<td>16 20 1 120 7 50%</td>
<td>1 1 1 50 2 15 1 120 3</td>
<td>72% 50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
<td>18</td>
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<tr>
<td></td>
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<td>General Service</td>
<td>P-46 General Group</td>
<td>P-46</td>
<td>16 20 1 120 7 50%</td>
<td>1 1 1 50 2 15 1 120 3</td>
<td>72% 50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
<td>18</td>
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<td></td>
<td>General Service</td>
<td>P-47 General Group</td>
<td>P-47</td>
<td>16 20 1 120 7 50%</td>
<td>1 1 1 50 2 15 1 120 3</td>
<td>72% 50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
<td>18</td>
<td>36</td>
<td>50%</td>
<td>18</td>
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Notes:
- See Performance Lighting for branch distribution.
- Receptacles typically represent 200W of lighting load per circuit. Load specified as average load. Luminaires are sized so that voltage drop does not exceed 8%.
- Neutral is usually doubled.
- Transformer Demand is a rough estimate; it is really dependent on the architectural lighting design.
- Load is specified at the MBP. Average Length 80'. Conduit and wire size by others.
- Load is specified at the MBP. Average Length 120'. Conduit Size 1" metallic.

Theatre Consultants Collaborative, Inc
### Schedule - Recital Hall

#### Lighting Group

<table>
<thead>
<tr>
<th>P-49</th>
<th>Dimmer Room</th>
<th>Automated Fixtures</th>
<th>Motorized Breaker Panel Board</th>
<th>1 1 200 3 120</th>
<th>72 40%</th>
<th>20</th>
</tr>
</thead>
</table>

- Description: See Performance Lighting Faceplate (below) for branch distribution.
- Notes: Receptacles typically represent 20A distribution from MBP in clusters of 2, on the average. Load specified at the MBP. Average Length 60'. Conduit and wire size by others.

<table>
<thead>
<tr>
<th>P-50</th>
<th>Theatre</th>
<th>Portable Stage Lighting Fixtures</th>
<th>Perf Lighting Faceplate</th>
<th>24 24 20 1 120</th>
<th>58</th>
</tr>
</thead>
</table>

- Notes: Average Length 100'; Conduit Size 1" metallic

<table>
<thead>
<tr>
<th>P-51</th>
<th>Follow Spot</th>
<th>Follow spots, etc.</th>
<th>Plug-In Bussway</th>
<th>1 1 100 3 120</th>
<th>36 35%</th>
<th>13</th>
</tr>
</thead>
</table>

- Notes: 5' busway

#### Emergency Lighting Group

<table>
<thead>
<tr>
<th>P-52</th>
<th>Dimmer Room</th>
<th>Processing rack/EDMX</th>
<th>Receptacle</th>
<th>1 1 15 1 120</th>
<th>2 50%</th>
<th>1</th>
</tr>
</thead>
</table>

- Notes: The emergency Lighting transfer Switch can take 1 or 3 phase feed. Demand is a rough estimate - it is really dependent on the architectural lighting

<table>
<thead>
<tr>
<th>P-53</th>
<th>Dimmer Room</th>
<th>Emergency Lighting</th>
<th>ELTS Cabinet</th>
<th>1 1 60 3 120</th>
<th>22 50%</th>
<th>11</th>
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</thead>
</table>

- Notes: The emergency Lighting transfer Switch can take 1 or 3 phase feed. Demand is a rough estimate - it is really dependent on the architectural lighting

#### Total: Lighting Transformer

- Group Total - Lighting: 41 73% 30

#### Booth Group

<table>
<thead>
<tr>
<th>P-54</th>
<th>Control Booth</th>
<th>Computer</th>
<th>Receptacle</th>
<th>3 6 20 1 120</th>
<th>7 65%</th>
<th>5</th>
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</thead>
</table>

### Mach / Rigging Group

<table>
<thead>
<tr>
<th>P-48</th>
<th>Mach / Rigging Group</th>
<th>Future Hoists</th>
<th>Disconnect</th>
<th>1 1 100 3 120</th>
<th>36 75%</th>
<th>27</th>
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</thead>
</table>

- Notes: Diversified total: 63%
<table>
<thead>
<tr>
<th>Supply</th>
<th>Notes</th>
<th>Space Demand KW</th>
<th>Transformer Demand KW</th>
<th>Transformer Div. %</th>
<th>50%</th>
<th>80%</th>
<th>Total Group Demand KW</th>
<th>Group Div. %</th>
<th>Total This Space</th>
<th>Div. %</th>
<th>100%</th>
<th>100%</th>
<th>100%</th>
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<tbody>
<tr>
<td>Group Total - Booth</td>
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<td>5</td>
<td>100%</td>
<td>56</td>
<td>80%</td>
<td>44</td>
<td>76</td>
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<td>Demerit total: 62%</td>
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<td>12</td>
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<td>General Group</td>
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<td>Platform</td>
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<td>Receptacle</td>
<td>4</td>
<td>8</td>
<td>20</td>
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<td>120</td>
<td>10</td>
<td>75%</td>
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<td>P-56</td>
<td>FOH Catwalks</td>
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<td>Receptacle</td>
<td>4</td>
<td>8</td>
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<td>1</td>
<td>120</td>
<td>10</td>
<td>50%</td>
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<td>Group Total - General Machinery Rigging Group</td>
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<td>120</td>
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<td>43</td>
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<td>Group Total - Mach / Rigging</td>
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<td>Total: Other Transformer</td>
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<td>P-57</td>
<td>Audience Acoustic Adjustment</td>
<td>Total Other Transformer</td>
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<td>Group Total - Booth</td>
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<td>43</td>
<td>100%</td>
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<td>P-59</td>
<td>Schedule - Lobby</td>
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<td>Loading Dock</td>
<td>Buses, Trucks, AC</td>
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<td>Schedule - Common Areas</td>
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<td>Demand (kW)</td>
<td>Group Div. %</td>
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<tr>
<td>P-82</td>
<td>Scene Shop</td>
<td>Large Power Tools</td>
<td>Receptacle</td>
<td>5</td>
<td>5</td>
<td>30</td>
<td>3</td>
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<td>Power Tools</td>
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<td>Lighting Shop Group</td>
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<tr>
<td>P-84</td>
<td>Tech Storage/Shop</td>
<td>Performance Lighting</td>
<td>Receptacle</td>
<td>4</td>
<td>8</td>
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<td>Receptacle</td>
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<td>50%</td>
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<tr>
<td>P-86</td>
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<td>Performance Lighting</td>
<td>NEMA L6-20</td>
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<td>4</td>
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<td>Total: Other Transformer</td>
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**Facility Totals**

<table>
<thead>
<tr>
<th>Subtotal:</th>
<th>Lighting Transformer</th>
<th>Total</th>
<th>Diversified Total</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>Sound Transformer</td>
<td>201</td>
<td>182</td>
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<tr>
<td>Subtotal:</td>
<td>Other Transformer</td>
<td>N</td>
<td>240</td>
</tr>
</tbody>
</table>
| Performance Equipment Facility Total | 310 | 266 | Diversified total: 85%

**Notes:**

- **M** 4-0 Earth ground bar in this area tied back to a single point of ground at the building grounding mat.
- **I** Isolated Ground Service with one isolation transformer feeding service, dedicated grounding riser and minimal panel boards
- **X** Figures are per unit:
  - If Gas there is one 3/4 Hp motor, one 1/2" Gas Lines, 160,000 btuh
  - If Hi Pressure Steam one 3/4 Hp motor, one 144.7 lb/hr line
  - If Low Pressure Steam one 3/4 Hp motor, one 128.2 lb/hr line

**Revision History**

1
2 D:\Dropbox (TheatreConsultantsCo)\_ProjectFiles\_TCC-Shared\ETSU-15\SD\Loading Reports\[999elec PEL-1 v2.xlsm][999ELEC]
East Tennessee State University Fine Arts Classroom Building

100% DESIGN DEVELOPMENT

ACOUSTICS

GUIDELINES

MARCH 13, 2017

SUBMITTED TO
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KNOXVILLE, TN 37902
T | 865.544.2000 x301
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011 INTRODUCTION

East Tennessee State University is in the process of developing a new fine arts center. Efforts are underway for programming and architectural/engineering design planning for a new building to house fine arts programs currently utilizing spaces in the existing buildings. Expertise is needed to address the acoustical needs for the new facility.

This report is intended to assist the architects and engineers in achieving the acoustical design criteria for the facility through practical, cost-effective design and construction. This report is also intended to assist the cost consultants in developing cost estimates that reflect the needs to achieve an acoustical environment that supports the prioritized use of each acoustically critical space in the new facility. This report includes:

- Our understanding of the program – including acoustically-critical spaces, expectations of acoustic quality, anticipated use, and scope of services.
- Room acoustics requirements to meet the program – including room geometry, and adjustable acoustics.
- Construction and finishes.
- General guidelines for control of noise and vibration from mechanical and electrical systems – including noise criteria.

This report is based on team meetings as well as responses to the Programming Questionnaire issued by Acoustic Distinctions.

This report should be thoroughly reviewed by the appropriate members of the university and design team for accuracy in the design intent. Please voice any clarifications or changes to the intent of the design to Acoustic Distinctions to ensure accurately prioritized program requirements.
LIST OF ACOUSTICALLY-CRITICAL SPACES

This report concerns the requirements for the following spaces:

- Multipurpose Auditorium / Concert Hall
- Studio Theatre
- Recital Hall
- Control/Sound Booths (to support the 3 spaces above)
- Large Instrumental Rehearsal
- Choir Rehearsal Room
- Percussion Rehearsal Rooms (Large & Small)
- Percussion Offices
- Music Offices
- Piano Storage Room
- Green Rooms
- Public Lobby
- Scene Shop
- Mechanical Rooms
- Electrical/IT/Telecom Rooms

ARCHITECTURAL DESIGN

ACOUSTICAL REQUIREMENTS FOR THE MULTI-PURPOSE AUDITORIUM AND THE OTHER PERFORMANCE SPACES

Since the program of use of the multi-purpose auditorium presents such a wide range of acoustic requirements, the acoustic design must include adjustable acoustic elements to provide the ability to control reverberant level and loudness. The room must provide a wide range of reverberance to support everything from choral concerts to amplified musical theatre, and must also return an adequate amount of sound energy to the performance platform to provide necessary feedback to the musicians without adversely affecting amplified programs.

Music performance spaces must also provide a good density of lateral reflections to listeners in order to achieve a feeling of spaciousness and envelopment.

Control of the ever-present background noise from mechanical systems is always a top priority for all performance spaces. For first class performance halls, it becomes essential to have the quietest conditions possible. Since there will be moments of silence that are integral parts of a musical or theatrical performances to occur in the performance spaces, background noise levels should be as close to inaudible as possible. A truly excellent performance space must be extraordinarily quiet. Achieving this goal requires a strong commitment from all members of the design team.

Control of intrusive noise is similarly crucial, although the frequency of occurrence of intrusive events is sometimes a design consideration, depending on site location and activities in adjacent areas. In general no noise from outside (rain storms, trains, aircraft, car horns, etc.) should be audible within any of the performance spaces. All of the performance spaces should be sound isolated from all other occupied spaces in the building so that no activities in the rest of the building can be heard within the performance spaces.
ROOM ACOUSTICS

The greatest challenge is that the auditorium, in order to accommodate the top prioritized elements of the anticipated program, must support both dramatic and musical activities.

To accommodate theatre or other staged productions, a proscenium is required for visual masking, and wing space is required. This is in contrast to a concert hall where there is no proscenium wall and where the musicians play in the same acoustical volume as the audience. In an auditorium that is required to support both staged productions and music performance, a great deal of adjustability is desired, including flexibility in the proscenium width and height. We recommend the proscenium width be able to be opened to no less than 60 ft and that the proscenium height be able to be opened to no less than 40 ft. We anticipate that masking legs and borders will be provided to reduce these dimensions for theatrical productions.

The greatest challenge is the need to provide an appropriate acoustical environment for music in an auditorium that is in the form of a theatre.

The size and shape of the audience chamber, and its relationship with the size and shape of the acoustical shell, can create two very different acoustical environments, resulting in minimal feedback or support in the musicians’ performance area from the audience chamber. This acoustical feedback from the audience chamber back to the performance platform is considered to be an essential element of good acoustics. It signals to the musicians that their sound is getting to the audience. This is a particularly important factor in a school where the focus is on the experience for the student performers.

The following flexible elements are recommended to allow the building to be transformed from a theatre to a concert hall:

- Stage Extension
- Concert Towers
- Concert Ceiling
- Adjustable Proscenium
- Adjustable Sound Absorption Elements

For music performance, the stage extension is raised to stage level, allowing some musicians to play in the same acoustical volume as the audience (as in a traditional concert hall). The stage extension can also be set at audience level for additional seating for special events. It can also be lowered below audience level to form an orchestra pit.

The concert towers and ceiling form an enclosure around the orchestra, helping the musicians to hear each other, helping their sound to project into the hall. For recitals and some chamber music, the towers would be set up just behind the proscenium, creating a more intimate setting. For larger groups of musicians, the towers would be set up further upstage. The concert towers will be designed to provide a full enclosure around ensembles up to 80 players; for unusual events with larger forces, or when a large choir accompanies a full orchestra, the concert towers would have to be spread out somewhat.

A dedicated storage area off stage is programmed for the large rolling towers so that they do not interfere with staged productions.
Acoustical Scale
The most important determinant of a hall’s acoustical properties is the room size, which, in plan, is typically determined by the seat count requirements and conformation of seating within the volume. The seat count of 750 is small enough for creating the sense of musical intimacy required by the small ensembles that will use this space. The acoustical scale of a room with this seating capacity is certainly appropriate for musical theatre, although the acoustical scale is on the small side. The acoustical scale of a 750-seat room is well below optimum for most symphonic music, and for large wind ensembles. One challenge, particularly for more powerful forces, such as the wind ensemble, is excessive loudness. In a room with a small acoustical scale, excessive loudness in the audience seating area can be overcome to a large extent by providing sufficient room volume (room height). Excessive loudness on the performance platform can be controlled to a large extent by setting the concert ceiling at a higher elevation, and by providing gaps between the concert towers.

In order to capture maximum volume (ceiling height) at a minimum of cost, it is anticipated that the underside of the roof deck over the audience chamber will act as the acoustical ceiling in the hall. In order to address concerns of visual aesthetics, and to provide for early sound reflections from above to maintain sufficient acoustical clarity, some acoustically reflective suspended ceiling should be provided, with openings to effectively couple the volume between the ceiling and roof above, with the volume below (between the ceiling and the seating area below).

Room Shaping
The seating rake and conformation of the audience seating in the Hall has a profound impact on the room acoustics. The seating rake must be sufficiently shallow to not shadow the side walls from sound that emanates from the performance platform. This must be balanced with the needs for adequate sightlines to the performers.

The room width must be limited to ensure for strong lateral sound reflections to the audience, which creates a strong sense of spaciousness, intimacy and envelopment. A narrow room width also helps to reduce the discontinuity at the proscenium, which has a limited room width, as required for visual masking, and to control the size of the proscenium opening, which must have the ability to be closed off by a fire curtain. In addition, there should be at least one soffit that runs along the side walls to “catch” sound emanating from the stage towards the side walls, and redirect this sound back down into the main audience seating area. These soffits may be created by seating ledges, or by technical circulation/catwalks. In order to be acoustically effective, the underside of these soffits must be level. Sloped or stepped soffits can be self-shadowing; the entire underside of these soffits must be “visible” to sound emanating from the stage.

Such early lateral reflections add acoustic clarity to the sound, beneficially broaden the apparent width of the musical source and contribute to a feeling of envelopment by the sound. The soffit should be constructed with heavy, stiff sound reflective materials, such as multi-layer GWB.

Recommended Finishes
The program of use of the Multi-purpose Auditorium/Concert Hall and the Recital Hall requires a wide range of acoustic adjustability. To provide this sort of flexibility, adjustable acoustic elements are strongly recommended. One suggested approach is to provide retractable sound-absorbing curtains to cover at least 75% of the hall’s wall surfaces. The fixed finishes of the halls should be primarily sound reflective to maximize liveness and reverberation for unamplified music and singing. The extent of fixed sound absorbing materials will be relatively limited.
The curtains will provide the ability to vary the reverberant level in the room from relatively low, to support theatrical productions, to a much higher level, to support a great deal of choral and symphonic music literature. The curtains will also provide ability to control loudness. Depending on which curtains are extended there will be an ability to control loudness and still maintain an appropriate reverberant level. Extending all curtains will provide good intelligibility of the spoken word, and will provide a more appropriate and controlled acoustical environment for jazz, bluegrass, and some other contemporary musical styles that may be performed in the hall.

The floor finishes in the halls in the seating areas should be hard and sound reflective – materials such as stained or brushed concrete are acceptable.

The need to sustain the low frequency sound energy in the music performance spaces, important to provide a sense of warmth and tonal balance, necessitates heavy constructions such as solid concrete or masonry for the large wall surfaces. If a finish other than exposed masonry is desired on these surfaces, a skim coat of plaster is recommended. Furred finishes should be avoided, as these will create bass trapping that will reduce the warmth of tone of the room’s natural acoustics. Smaller wall surfaces should be constructed with multi-layer gypsum board construction.

03| ROOM DATA SHEETS

The following section describes the sound isolating constructions, acoustic finishes, and mechanical system design criteria that we recommend for this project. Recommendations are organized by room type.
MULTIPURPOSE AUDITORIUM / CONCERT HALL

Acoustical Requirements and Programmed Use
Space for music and theatre performances. The following table lists school and community ensembles that may use this room.

Table 1: Multipurpose Auditorium / Concert Hall Programmed Use

<table>
<thead>
<tr>
<th>ACTIVITY/ENSEMBLE</th>
<th>SIZE</th>
<th>PRIORITY / REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Musical Production</td>
<td>25-40 in cast</td>
<td>Pit orchestra of up to 25</td>
</tr>
<tr>
<td>Opera</td>
<td></td>
<td>Pit orchestra of up to 35</td>
</tr>
<tr>
<td>Bluegrass/Country Music</td>
<td>6-10</td>
<td></td>
</tr>
<tr>
<td>Dance</td>
<td>30 performers on stage</td>
<td></td>
</tr>
<tr>
<td>Wind Ensemble</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Concert Band</td>
<td>45</td>
<td>Growth to 75</td>
</tr>
<tr>
<td>Jazz Band</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Percussion Ensembles</td>
<td>15-20</td>
<td>Growth to 20-25</td>
</tr>
<tr>
<td>Orchestra</td>
<td>75</td>
<td>Growth to 100</td>
</tr>
</tbody>
</table>

Sound Isolation Construction

Walls
- Between Auditorium and Exterior: 12” thick solid masonry construction + 4” thick exterior skin (brick), with 2 3/8” airspace. Other constructions such as precast planks can be explored.
- Between Auditorium and Front of House interior, M12-2: 12” thick solid masonry construction + 1” minimum airspace, 3-5/8” min. thickness metal stud filled with 3” thick mineral wool batt insulation with (2) layers 5/8” gypsum board on corridor side, refer to ADI Drawing 25.
- Between Auditorium and Back of House interior, M12: 12” thick solid masonry construction.
  For exact partition locations, see ADI Drawings M1-M3.

Roof
- Min. 12-inch thick concrete slab plus water/weather proofing (150 psf min. surface density)

Floor
- Concrete slab with 1-inch isolation joints around perimeter on outer (corridor side) of masonry wall.

Doors
- See Sound and Light Locks. STC-54 Door at loading dock entrance. Vertical instead of swinging STC door available from Jamison or Sound Seal.

Ceiling Height

- To Deck/Sound Isolation Ceiling 50’. The minimum volume of room, including footprint of stage, up to 35’ above stage level, should be no less than 600,000 cubic feet.
- To Suspended Clouds/Top of Proscenium/DIVA Ceiling 30’ AFF of stage
Acoustic Finishes

Room Shaping
A horizontal 3’ deep soffit (acoustic shelf) is recommended to wrap around the room, 10-14’ above the main floor level in order to provide enhanced acoustical clarity for the audience. Walls near proscenium opening are angled out toward the hall to help smooth the discontinuity in width between Hall and Proscenium, and shelf continues along these splay walls to create architectural continuity with the lower shelf of the Concert Towers. Walls/soffit are angled under follow spot and under balcony to prevent echoes returning to stage, and to enhance rear (overhung) seats on the floor, and seats in the balcony.

Walls/soffit are angled under follow spot and under balcony to prevent echoes returning to stage, and to enhance rear (overhung) seats on the floor, and seats in the balcony.

Ceiling
Clouds:
Suspended wood or gypsum board clouds at 30 ft AFF at the stage. These reflective ceiling elements should have a minimum weight of 7.5 psf., equivalent to three layers of 5/8” gypsum board on suitable steel framing systems. They should be convex down with 3 equilateral facets. In plan, they are to range in size from 6’ by 8’ up to 14’-6” by 8’, only exception being that the the first row (by proscenium should be wider, 10-12’ instead of 8’. Budget for a min. of 22-28 of these cloud elements in the audience seating area. This should be configured as an array of panels in 5 rows with several (4-6) panels in each row. Array should be arranged flat, i.e. parallel to floor. Vary the distance between panels from 1’-6” to 5’, make rows different from adjacent rows, some with an odd number of panels, some with an even number of panels, but symmetric about the long axis of the room, see ADI Drawing 34A.

Wenger Diva Stage Ceiling:
Flown DIVA ceiling elements, most massive model made by Wenger (highest psf), approx. 4000 SF or almost 100% coverage of entire stage house plan area, 5 rows. When fully deployed, ceiling elements will block off sound-absorbing theatrical soft goods, and create a reverberation chamber in the stage wings, behind the concert towers. There is a 6’ space between the top of the towers (24’ AFF) and the height of the ceiling elements (30’) to allow sound to pass over into the reverberation chamber wings, see ADI Drawing 34A.

Concert Towers
Wenger Diva 26’ concert towers, with (2) acoustic shelves built into the design at 13’ AFF (matching side shelves in the Hall and on proscenium splay walls) and 24’ AFF. (8) 3-panel towers, with 12’ span, as massive as Wenger can make (highest available psf).

Walls
Minimum weight 7.5 psf. Recommended: Skim coat of plaster on the CMU, or exposed CMU if sealed smooth and pinhole free. Wood paneling is not recommended, and is acceptable only if there are (2) layers of sufficiently thick wood, (i.e. thin single layer of wood sheathing unacceptable), three layers of 5/8” gypsum board is equivalent. Randomized textured and/or faceted decorative surfaces can create sound diffusion, if visually desirable.

Adjustable acoustic curtains (curtain pockets required). Curtains should be 25 oz. heavy cotton velour, sewn with 100% fullness, and incorporate a 16 oz. backing layer, sewn flat. 75% wall coverage
Side walls: 3 levels of curtains: Main Level (below acoustic shelf), Balcony Level (above acoustic shelf), Catwalk Level

Floor
Sound reflective surface (e.g., wood, stained concrete, VCT), carpet on the aisles.

Mechanical System Design

Noise Criteria
RC-15
STUDIO THEATRE

Acoustical Requirements and Programmed Use
Flexible space for theatre department performances.

Sound Isolation Construction

Walls
To Scene Shop (double height): 8” Grout filled CMU + 4” airspace + 6” grout filled CMU. 8” CMU is Studio Theatre side; 6” CMU is Scene Shop Side, ADI Drawing 27.
Partitions run slab-to-slab.
Between Theatre and remaining interior corridors, M8: 8” thick solid masonry construction.

Roof
Min. 10-inch thick concrete slab plus water/weather proofing (125 psf min. surface density)

Floor
Concrete slab with 1-inch isolation joints around perimeter, shown on ADI Drawing M4.

Doors
See Sound and Light Locks. STC-54 Door at Scene Shop Crossover. Vertical instead of swinging STC door available from Jamison or Sound Seal.

Ceiling Height
To Deck/Sound Isolation Ceiling As low as possible (minimum ceiling height that does not compromise lighting positions).

Acoustic Finishes

Ceiling
Budget for 2” thick duct liner board 50% coverage.

Walls
1) Adjustable acoustic curtains (curtain pockets not required). Curtains should be 25 oz. heavy cotton velour, sewn with 100% fullness, and incorporate a 16 oz. backing layer, sewn flat. 50% wall coverage.
2) 2” thick 6 pcf fiberglass core acoustical panels over about 30% of the wall surface.

Floor
Resilient stage floor construction.

Mechanical System Design

Noise Criteria
RC-20
**RECITAL HALL**

**Acoustical Requirements and Programmed Use**

Space for smaller music performances recitals. A majority of uses will have 2-5 players. The following table lists the groups that may use this room. The 500 SF platform is for preferably no more than 15 musicians, so that with the 35' height, the ensemble will not overpower the room. See ADI Drawings 28-32 for anticipated ensemble types.

<table>
<thead>
<tr>
<th>Table 2: Recital Hall Programmed Use</th>
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</thead>
<tbody>
<tr>
<td><strong>ENSEMBLE</strong></td>
</tr>
<tr>
<td>Solo Recital</td>
</tr>
<tr>
<td>4 hand piano</td>
</tr>
<tr>
<td>Chamber music ensembles</td>
</tr>
</tbody>
</table>

**Sound Isolation Construction**

- **Walls**: Between hall and exterior, 10" thick solid masonry construction + 4" thick exterior skin (brick), with 2 3/8" airspace, see ADI Drawing M1. Between hall and interior, M10-2: 10" thick solid masonry construction + 1" minimum airspace, 3-5/8" min. thickness metal stud filled with 3" thick mineral wool batt insulation with (2) layers 5/8" gypsum board on corridor side, refer to ADI Drawing 25.
- **Roof**: Min. 10-inch thick concrete slab plus water/weather proofing (125 psf min. surface density)
- **Floor**: Concrete slab with 1-inch isolation joints around perimeter on outer (corridor side) of masonry wall, shown on ADI Drawing M4.
- **Doors**: See Sound and Light Locks.

**Ceiling Height**

- **To Deck/Sound Isolation Ceiling**: 35'
- **To Suspended Clouds**: 20’ typical

**Acoustic Finishes**

- **Room Shaping**: A horizontal 3’ deep soffit (acoustic shelf) is recommended to wrap around the room, 10-14’ above the main floor level in order to provide enhanced acoustical clarity for the audience. Additional shelf is the underside of the catwalk in the upper volume of the room. Walls near proscenium opening are angled and convexly curved out toward the hall to help smooth the discontinuity in width between Hall and Proscenium.

- **Ceiling**: Suspended wood or gypsum board clouds at 18-22 ft AFF. These reflective ceiling elements should have a minimum weight of 5 psf., equivalent to two layers of 5/8" gypsum board on suitable steel framing systems. 50% of stage ceiling area coverage; 30% of audience seating area coverage.
  This should be configured as an array of panels approximately 4’ by 8’, 3 rows with 3-4 panels in each row. Array should be arranged flat, i.e. parallel to floor. Each individual panel should be flat or convexly curved. The rows above the stage are at 19-20’ above the stage. The row of panels above the audience must not “flare up” but instead remain arranged flat like those over the stage, this row is at 22’ above the stage.
Walls
Minimum weight 7.5 psf. Recommended: Skim coat of plaster on the CMU, or exposed CMU if sealed smooth and pinhole free. Wood paneling is not recommended, and is acceptable only if there are (2) layers of sufficiently thick wood, (i.e. thin single layer of wood sheathing unacceptable), three layers of 5/8” gypsum board is equivalent. Randomized textured and/or faceted decorative surfaces can create sound diffusion, if visually desirable.
Adjustable acoustic curtains (curtain pockets required). Curtains should be 25 oz. heavy cotton velour, sewn with 100% fullness, and incorporate a 16 oz. backing layer, sewn flat. 75% wall coverage.
Side walls: 2 levels of curtains: Main Level (below acoustic shelf), Balcony Level (above acoustic shelf).
Side Stage Walls: Custom theatre equipment tracked panel walls, absorptive on one side, reflective randomized textured and/or faceted surface on the other.
Upstage Wall: 2 levels of curtains: Main Level (below acoustic shelf), Balcony Level (above acoustic shelf).

Floor
Sound reflective surface (e.g., wood, stained concrete, VCT), carpet on the aisles.

**Mechanical System Design**
**Noise Criteria** RC-15
CONTROL / SOUND BOOTHS (AUDITORIUM, RECITAL, STUDIO THEATRE)

Acoustical Requirements and Programmed Use
Control room dedicated/attached to the primary performance spaces: Auditorium, Recital Hall, and Studio Theatre.

Sound Isolation Construction
Walls
To Performance Space and SLLs, Single stud partition PS-22:
(1) 3-5/8" min. thickness metal stud filled with 3" thick mineral wool batt insulation.
5/8" gypsum board, (4) layers total between adjacent spaces, see ADI Drawings M1-M2.
Partitions run slab-to-slab.

Ceiling: N/A
Floor: N/A

Doors
Sound and light locks or STC-51 rated doors, Refer to ADI Drawings 01, 02, and for exact locations M1-M2.

Windows
3/8” laminated glass, 1” airspace, 3/8”laminated glass at a 5 degree angle in the control room side. Refer to ADI Drawing 04. Alternately, use a double sliding sound rated window, DeVac Model 650AL-2E or similar (STC-50 rated) if room is used as a mix position.

Ceiling Height
To Deck/Sound Isolation Ceiling: 14’
To ACT: 12’

Acoustic Finishes
Ceiling
Acoustical ceiling tile, min. NRC 0.70, 100% coverage of ceiling area.

Walls
2” thick fabric wrapped fiberglass (6 pcf density) panels start at 36” AFF, 75% wall coverage (rear wall and both side walls).

Floor
Sound reflective surface (e.g., wood, stained concrete, VCT directly behind mix console and table (to facilitate rolling chairs); other areas to be carpeted.

Mechanical System Design
Noise Criteria: RC-20
SOUND AND LIGHT LOCKS

Acoustical Requirements and Programmed Use

Transition space from spaces to corridor/lobby areas, used as entrance/exit to rooms with high sound isolation requirements.

Sound Isolation Construction

Walls
Single stud partition:
3-5/8” min. thickness metal stud filled with 3” thick mineral wool batt insulation.
5/8” gypsum board, (4) layers total to corridor and between adjacent rooms.
All partitions between rooms run slab-to-slab.

Floor
N/A

Doors
Solid core wood or insulated hollow metal doors with butt hinges and perimeter sound seals.
Please refer to the attached ADI Drawing 01. Inner doors (adjacent to noise critical spaces) should have no latching hardware.

Ceiling Height

To Deck/Sound Isolation Ceiling
N/A

To ACT
N/A

Acoustic Finishes

Ceiling
Acoustical ceiling tile, min. NRC 0.70, 100% coverage of ceiling area.

Walls
2” thick sound absorptive treatment, min. NRC 0.80, 50% min. coverage of all walls.

Floor
Carpet

Mechanical System Design

Noise Criteria
N/A
| **RACK/DIMMER ROOM** |

**Acoustical Requirements and Programmed Use**
Room accommodates dimmers/electrical distribution equipment and/or audio/video/communications equipment.

**Sound Isolation Construction**

- **Walls**
  - Single stud partition: 3-5/8” min. thickness metal stud filled with 3” thick mineral wool batt insulation.
  - 5/8” gypsum board, (4) layers total to corridor and between adjacent rooms.
  - All partitions between rooms run slab-to-slab.

- **Floor**
  - N/A

- **Doors**
  - Solid core wood or insulated hollow metal doors with butt hinges and perimeter sound seals. Please refer to the attached ADI Drawing 01. Inner doors (adjacent to noise critical spaces) should have no latching hardware.

**Ceiling Height**

- **To Deck/Sound Isolation Ceiling**
  - N/A

- **To ACT**
  - N/A

**Acoustic Finishes**

- **Ceiling**
  - N/A

- **Walls**
  - 2” thick duct liner board on two adjacent walls, 100% coverage.

- **Floor**
  - N/A

**Mechanical System Design**

- **Noise Criteria**
  - N/A
LARGE INSTRUMENTAL REHEARSAL

Acoustical Requirements and Programmed Use
Space for large instrumental bands/ensembles. A majority of uses will have 20-50 players, see the following table.

Table 3: Large Instrumental Rehearsal Room Programmed Use

<table>
<thead>
<tr>
<th>ENSEMBLE</th>
<th>SIZE</th>
<th>PRIORITY / REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concert Band</td>
<td>45</td>
<td>Potential growth to 75</td>
</tr>
<tr>
<td>Jazz Band</td>
<td>20</td>
<td>Potential growth to 20</td>
</tr>
<tr>
<td>Drum Line</td>
<td>26</td>
<td>Potential growth to 50</td>
</tr>
<tr>
<td>Large Choirs</td>
<td>80+</td>
<td></td>
</tr>
</tbody>
</table>

Sound Isolation Construction

Walls
Between Rehearsal and exterior, (1) 3-5/8” min. thickness metal stud filled 3” thick mineral wool batt and (2) layers 5/8” gypsum board + 2 3/8” airspace + 4” thick exterior skin (brick).
Between Rehearsal and interior, Double stud partition PD-22:
(2) 3-5/8” min. thickness metal studs filled with 3” thick mineral wool batt insulation, 1” airspace between studs.
5/8” gypsum board, (4) layers total to adjacent spaces.
Partitions run slab-to-slab.

Roof
4” Concrete or similar mass loading of the roof deck; 50-psf minimum

Floor
On-grade, concrete slab with 1-inch isolation joints around perimeter (in the air gap between the double studs). Refer to ADI Drawing 06a.

Doors
See Sound and Light Locks, see ADI Drawing M1.

Windows
We recommend against exterior windows due to intrusive noise. If windows must be included, schedule 1” insulating glass: 1/4” laminated glass, 1/2” airspace, 1/4” laminated glass.

Ceiling Height
To Deck/Sound Isolation Ceiling 30’ minimum
To Suspended Clouds 19-22’ typical

Acoustic Finishes

Room Shaping
A horizontal soffit is recommended to wrap around the room, 10-14’ above the main floor level in order to provide enhanced acoustical clarity and support for instrumentalists.

Ceiling
Suspended wood or gypsum board clouds with a minimum weight of 2.5 psf., equivalent to one layer of 5/8” gypsum board on suitable steel framing systems. 50% of ceiling area coverage. 3” batt insulation on the top side of the reflective ceiling elements.
Budget for 2” thick duct liner board 100% coverage of the underside of the roof deck.

Walls
1) Adjustable acoustic curtains (curtain pockets not required). Curtains should be 25 oz. heavy cotton velour, sewn with 100% fullness, and incorporate a 16 oz. backing layer, sewn flat. 40% wall coverage.
2) 2” thick fabric wrapped fiberglass (6 pcf density) panels, 20% coverage on all walls.
3) Varied angled architectural surfaces help diffuse sound, creating uniform acoustics.

Floor
Sound reflective surface (e.g., wood, stained concrete, VCT).
Mechanical System Design

Noise Criteria  RC-25
**CHOIR REHEARSAL**

**Acoustical Requirements and Programmed Use**

Space for choral rehearsals. A flat floor space is desired to provide flexibility for numerous layouts, including seated risers and standing risers (so riser storage nearby is essential).

**Table 4: Choir Rehearsal Room Programmed Use**

<table>
<thead>
<tr>
<th>ENSEMBLE</th>
<th>SIZE</th>
<th>PRIORITY / REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men's Choir</td>
<td>50</td>
<td>Growth to 100</td>
</tr>
<tr>
<td>Women's Choir</td>
<td>50</td>
<td>Growth to 100</td>
</tr>
<tr>
<td>Jazz</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Auditioned Chorale</td>
<td>40-45</td>
<td></td>
</tr>
</tbody>
</table>

**Sound Isolation Construction**

- **Walls**
  - Between Rehearsal and exterior, (1) 3-5/8" min. thickness metal stud filled 3" thick mineral wool batt and (2) layers 5/8" gypsum board + 2 3/8" airspace + 4" thick exterior skin (brick).
  - Between Rehearsal and interior, Double stud partition PD-22:
    - (2) 3-5/8" min. thickness metal studs filled with 3" thick mineral wool batt insulation, 1" airspace between studs.
    - 5/8" gypsum board, (4) layers total to adjacent spaces.
    - Partitions run slab-to-slab.

- **Roof**
  - 4" Concrete or similar mass loading of the roof deck; 50-psf minimum

- **Floor**
  - On grade, concrete slab with 1-inch isolation joints around perimeter. Refer to ADI Drawing 06a.

- **Doors**
  - See Sound and Light Locks, Door to the exterior is STC-54 rated.

**Ceiling Height**

- To Deck/Sound Isolation Ceiling: 25'
- To Suspended Elements: 15-18'

**Acoustic Finishes**

- **Room Shaping**
  - A horizontal soffit is recommended to wrap around the room, 10-14' above the main floor level in order to provide enhanced acoustical clarity and support for choral members.

- **Ceiling**
  - Suspended wood or gypsum board clouds with a minimum weight of 2.5 psf., equivalent to one layer of 5/8" gypsum board on suitable steel framing systems. 50% of ceiling area coverage. 3" batt insulation on the top side of the reflective ceiling elements.

- **Walls**
  - 4) Adjustable acoustic curtains (curtain pockets not required). Curtains should be 25 oz. heavy cotton velour, sewn with 100% fullness, and incorporate a 16 oz. backing layer, sewn flat. 50% wall coverage.
  - 5) 2" thick fabric wrapped fiberglass (6 pcf density) panels, 20% coverage on all walls.

- **Floor**
  - Sound reflective surface (e.g., wood, stained concrete, VCT)

**Mechanical System Design**

- **Noise Criteria**
  - RC-25
PERCUSSION REHEARSAL – LARGE

Acoustical Requirements and Programmed Use
Space for percussion rehearsals, accommodating up to 20 instrumentalists with all standard and orchestral and band percussion instruments such as large marimbas, timpani, tams, etc.

Sound Isolation Construction

Walls
- Percussion Rehearsal to Percussion or Choral Rehearsal, MD8-22: 8" thick solid masonry construction, see ADI Drawing 26.
- 3-5/8" min. thickness metal studs filled with 3" thick mineral wool batt insulation on each side of masonry, 1" airspace between each stud and masonry.
- 5/8" gypsum board, (4) layers total to adjacent spaces.
- Percussion Rehearsal to Corridor, M8-2: 8" thick solid masonry construction
- (1) 3-5/8" min. thickness metal stud filled with 3" thick mineral wool batt insulation on rehearsal side of masonry, 1" airspace between stud and masonry.
- 5/8" gypsum board, (2) layers on rehearsal side stud.
- Masonry partition runs slab-to-slab.

Ceiling Isolated joist ceilings where feasible; otherwise, spring-supported GWB ceiling; using (3) layers of GWB for the ceiling, see ADI Drawings 10 and 11.

Roof
- 4" Concrete or similar mass loading of the roof deck; 50-psf minimum

Floor
- On-grade, concrete slab with 1-inch isolation joints around perimeter (in air gap between stud and masonry). Refer to ADI Drawing 26.

Doors
See Sound and Light Locks.

Ceiling Height
- To Deck/Sound Isolation Ceiling: 16'
- To ACT: 14'

Acoustic Finishes

Ceiling
- 1) Acoustical ceiling tile, min. NRC 0.70, 50% checkerboard coverage of ceiling area.
- 2) 2" thick duct liner board attached to the underside of the deck, 100% coverage.

Walls
- 1) Adjustable acoustic curtains (curtain pockets not required). Curtains should be 25 oz. heavy cotton velour, sewn with 100% fullness, and incorporate a 16 oz. backing layer, sewn flat. Upper level (6' AFF to 14' AFF) wall coverage of two adjacent walls.
- 2) 2" thick fabric wrapped fiberglass (6 pcf density) panels angled down 5°, 60% coverage on remaining wall areas.

Floor
- Sound reflective surface (e.g., wood, stained concrete, VCT)

Mechanical System Design

Noise Criteria
- RC-25
MUSIC OFFICES

Acoustical Requirements and Programmed Use
General music faculty offices and spaces for private lessons. Room-in-room construction required to meet minimum sound isolation requirements to achieve NASM guidelines of NIC 65 between adjacent music teaching studios. Note that some Dressing Rooms will be designed to double as music practice rooms; these dressing rooms will have similar acoustical construction and finishes requirements.

Sound Isolation Construction
Walls
To exterior: (1) 3-5/8” min. thickness metal stud filled 3” thick mineral wool batt and (3) layers 5/8” gypsum board + 2 3/8” airspace + 4” thick exterior skin (brick).
To adjacent Music Offices, Double stud partition PD-33:
(2) 3-5/8” min. thickness metal studs filled with 3” thick mineral wool batt insulation, 2” airspace between studs.
5/8” gypsum board, (6) layers between adjacent spaces.
To Corridor, Single stud partition PS-33:
(1) 3-5/8” min. thickness metal stud filled with 3” thick mineral wool batt insulation.
5/8” gypsum board, (6) layers total to corridor.
Partitions run slab-to-slab.

Ceiling
Isolated joist ceilings where feasible; otherwise, spring-supported GWB ceiling; see ADI Drawings 10 and 11.

Floor
On-grade, concrete slab with 1-inch isolation joints around perimeter (in air gap). Refer to ADI Drawing 06a.

Doors
STC-51 rated doors. Refer to ADI Drawing 02.

Ceiling Height
To Deck/Sound Isolation Ceiling 11’
To ACT 10’

Acoustic Finishes
Ceiling
Acoustical ceiling tile, min. NRC 0.70, 100% coverage of ceiling area.

Walls
2” thick 6 pcf fiberglass core acoustical panels. Picture-rail system from 2’ 6” to 8’-0” AFF, on all walls. Refer to ADI Drawing 05.

Floor
Sound reflective surface (e.g., wood, stained concrete, VCT)

Mechanical System Design
Noise Criteria
RC-30
GREEN ROOMS

Acoustical Requirements and Programmed Use
Warm up and storage space for guest performers. Room-in-room construction will be implemented to create sound isolation comparable to NASM guidelines for music offices. Since performers will practice in these rooms, the acoustical construction and finishes requirements are comparable to the music offices.

Sound Isolation Construction
Walls
To exterior: (1) 3-5/8” min. thickness metal stud filled 3” thick mineral wool batt and (3) layers 5/8” gypsum board + 2 3/8” airspace + 4” thick exterior skin (brick).
To adjacent rooms, Double stud partition PD-33:
(2) 3-5/8” min. thickness metal studs filled with 3” thick mineral wool batt insulation, 2” airspace between studs.
5/8” gypsum board, (6) layers between adjacent spaces.
To Corridor, Single stud partition PS-33:
(1) 3-5/8” min. thickness metal stud filled with 3” thick mineral wool batt insulation.
5/8” gypsum board, (6) layers total to corridor.
Partitions run slab-to-slab.

Ceiling
To Deck/Sound Isolation Ceiling: Isolated joist ceilings where feasible; otherwise, spring-supported GWB ceiling; see ADI Drawings 10 and 11.

Floor
On-grade, concrete slab with 1-inch isolation joints around perimeter (in air gap). Refer to ADI Drawing 06a.

Doors
STC-51 rated doors. Refer to ADI Drawing 02.

Ceiling Height
To Deck/Sound Isolation Ceiling 11’
To ACT 10’

Acoustic Finishes
Ceiling
Acoustical ceiling tile, min. NRC 0.70, 100% coverage of ceiling area.

Walls
2” thick 6 pcf fiberglass core acoustical panels. Picture-rail system from 2’ 6” to 8’-0” AFF, on all walls. Refer to ADI Drawing 05.

Floor
Sound reflective surface (e.g., wood, stained concrete, VCT)

Mechanical System Design
Noise Criteria RC-30
PIANO STORAGE ROOM

Acoustical Requirements and Programmed Use
Storage space performance grand pianos. Wall types provided give comparable sound isolation performance to NASM guidelines for music offices, since piano tuners will use this space simultaneous with Recital Hall use.

Sound Isolation Construction

Walls
To Recital: M10-2: 10” thick solid masonry construction + 1” minimum airspace, 3-5/8” min. thickness metal stud filled with 3” thick mineral wool batt insulation with (2) layers 5/8” gypsum board on piano storage side, refer to ADI Drawing 25.
To restroom: Double stud plumbing wall, (2) 3-5/8” min. thickness metal studs filled with 3” thick mineral wool batt insulation, 2” airspace + (2) layers gypsum between studs. 5/8” gypsum board (2) layers each side & (2) layers at airgap, (6) layers between adjacent spaces, see ADI Drawing 23.
To Corridor/SLL: Single stud partition PS-33:
(1) 3-5/8” min. thickness metal stud filled with 3” thick mineral wool batt insulation.
5/8” gypsum board, (6) layers total to corridor.
Partitions run slab-to-slab.

Ceiling N/A
Floor N/A
Doors Solid core wood or insulated hollow metal doors with butt hinges and perimeter sound seals.
Please refer to the attached ADI Drawing 01.

Ceiling Height
To Deck/Sound Isolation Ceiling 11’
To ACT 10’

Acoustic Finishes

Ceiling Acoustical ceiling tile, min. NRC 0.70, 100% coverage of ceiling area.
Walls 2” thick 6 pcf fiberglass core acoustical panels. Fixed panels from 2’ 6” to 8’-0” AFF, on two adjacent walls.
Floor Sound reflective surface (e.g., wood, stained concrete, VCT)

Mechanical System Design

Noise Criteria RC-30
PERCUSSION MUSIC OFFICES

Acoustical Requirements and Programmed Use

General music faculty offices and spaces for private lessons in percussion. Room-in-room construction required to meet minimum sound isolation requirements to achieve NASM guidelines, plus special considerations for percussion isolation between adjacent music teaching studios.

Sound Isolation Construction

Walls

- Percussion office to Percussion office, MD8-22: 8" thick solid masonry construction, similar to ADI Drawing 26.
- (2) 3-5/8” min. thickness metal studs filled with 3” thick mineral wool batt insulation on each side of masonry, 1” airspace between each stud and masonry.
- 5/8” gypsum board, (4) layers total to adjacent spaces.
- Percussion Rehearsal to Corridor, M8-2: 8” thick solid masonry construction
- (1) 3-5/8” min. thickness metal stud filled with 3” thick mineral wool batt insulation on rehearsal side of masonry, 1” airspace between stud and masonry.
- 5/8” gypsum board, (2) layers on rehearsal side stud.
- Masonry partition runs slab-to-slab.

Ceiling

- Isolated joist ceilings where feasible; otherwise, spring-supported GWB ceiling; using (3) layers of GWB for the ceiling, see ADI Drawings 10 and 11.

Floor

- On-grade, concrete slab with 1-inch isolation joints around perimeter (in air gap between stud and masonry). Refer to ADI Drawing 26.

Doors

- STC-54 rated doors. Refer to ADI Drawing 02.

Ceiling Height

- To Deck/Sound Isolation Ceiling: 11’
- To ACT: 10’

Acoustic Finishes

- Ceiling: Acoustical ceiling tile, min. NRC 0.70, 100% coverage of ceiling area.
- Walls: 2” thick 6pcf fiberglass core acoustical panels with enhanced low frequency absorption (i.e. RPG BAD panels or Kinetics TAD panels). Picture-rail system from 2’ 6” to 8’-0” AFF, on all walls. Refer to ADI Drawing 05.
- Floor: Sound reflective surface (e.g., wood, stained concrete, VCT)

Mechanical System Design

- Noise Criteria: RC-30
Percussion Rehearsal Rooms — Small

Acoustical Requirements and Programmed Use
Small spaces used for individual percussion practice.

Sound Isolation Construction

Walls
Percussion Rehearsal to Percussion Rehearsal, MD8-22: 8” thick solid masonry construction, see ADI Drawing 26.
(2) 3-5/8” min. thickness metal studs filled with 3” thick mineral wool batt insulation on each side of masonry, 1” airspace between each stud and masonry.
5/8” gypsum board, (4) layers total to adjacent spaces.
Percussion Rehearsal to Corridor, M8-2: 8” thick solid masonry construction
(1) 3-5/8” min. thickness metal stud filled with 3” thick mineral wool batt insulation on rehearsal side of masonry, 1” airspace between stud and masonry.
5/8” gypsum board, (2) layers on rehearsal side stud.
Masonry partition runs slab-to-slab.

Ceiling
Isolated joist ceilings where feasible; otherwise, spring-supported GWB ceiling; using (3) layers of GWB for the ceiling, see ADI Drawings 10 and 11.

Floor
On-grade, concrete slab with 1-inch isolation joints around perimeter (in air gap between stud and masonry). Refer to ADI Drawing 26.

Doors
STC-54 rated doors. Refer to ADI Drawing 02.

Ceiling Height
To Deck/Sound Isolation Ceiling 9’
To ACT 8’

Acoustic Finishes

Ceiling
1) Acoustical ceiling tile, min. NRC 0.90, 100% coverage of ceiling area.
2) 6” thick batt insulation above the ACT ceiling.

Walls
2” thick 6 pcf fiberglass core acoustical panels with enhanced low frequency absorption (i.e. RPG BAD panels or Kinetics TAD panels) on all walls from 1’ AFF to 1’ below finished ceiling.

Floor
Sound reflective surface (e.g., wood, stained concrete, VCT)

Mechanical System Design

Noise Criteria
RC-35
PUBLIC LOBBY

Acoustical Requirements and Programmed Use
Lobby space.

Sound Isolation Construction
Walls N/A
Doors N/A

Ceiling Height
To Deck N/A

Acoustic Finishes
Ceiling 2" thick duct liner board attached to the underside of deck, 100% coverage.
Walls Sound absorptive materials where feasible.
Floor N/A

Mechanical System Design
Noise Criteria RC-40
ACOUSTICAL REQUIREMENTS AND PROGRAMMED USE

Spaces for creating sets, woodwork, welding, painting, etc. This space will generate high levels of noise, and there is a need to have greater sound isolation to the Multipurpose Auditorium and the Studio Theatre.

SOUND ISOLATION CONSTRUCTION

Walls
To Studio Theatre & Crossover (double height): 8” Grout filled CMU + 4” airspace + 6” grout filled CMU. 8” CMU is Studio Theatre side; 6” CMU is Scene Shop Side.
Remaining Walls: M12 - 12” Grout-filled CMU construction.

Floor
The isolation cut around the Studio Theatre will pass along (1) side, in the airspace of the double CMU partition, see ADI Drawing 27.

Doors
D2: Full-perimeter sound seals. See ADI Drawing # 2010287-16. STC-54 door to Studio Theatre crossover.

ACOUSTIC FINISHES

Ceiling
Sound absorptive treatment, Min. NRC 0.90 (ACT or BASWAphon or Fellert Acoustic Plaster), 100% coverage of ceiling area.

Walls
Where possible in upper half of room, 2” thick duct liner board on two adjacent walls

Floor
N/A

MECHANICAL SYSTEM DESIGN

Noise Criteria
N/A

NOTES

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MECHANICAL ROOMS

Acoustical Requirements and Programmed Use
Mechanical Plant rooms housing all fans, air handlers, etc. that serve the facility.

Sound Isolation Construction
Walls  Solid load-bearing masonry construction.
Floor  Lower Level: Concrete slab on-grade with 1” expansion joint around perimeter. All equipment to have appropriate housekeeping pads, inertia bases, and spring and neoprene isolators.
       Upper Level: If mechanical room only has air handlers, no floating floor required just appropriate spring and neoprene vibration isolators. If there are other kinds of equipment, pumps, etc, a floating floor will be required, see ADI Drawing M6.
Doors  Solid core wood or insulated hollow metal doors with butt hinges and perimeter sound seals. Please refer to the attached ADI Drawing 01.

Acoustic Finishes
Ceiling N/A
Walls  2” thick duct liner board on the two longest adjacent walls, 100% coverage.
Floor  N/A

Mechanical System Design
Noise Criteria N/A

Notes
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ELECTRICAL/IT/TELECOM ROOMS

Acoustical Requirements and Programmed Use
Electrical and Information Technology Plant rooms housing racks, transformers, etc. that serve the facility.

Sound Isolation Construction
Walls  Single stud partition: PS-22
       3-5/8” metal stud filled with 3” thick mineral wool batt insulation.
       5/8” gypsum board, (4) layers total to corridor and between adjacent rooms.
       All partitions between rooms run slab-to-slab.

Floor  N/A
Doors  Solid core wood or insulated hollow metal doors with butt hinges and perimeter sound seals.
       Please refer to the attached ADI Drawing 01.

Acoustic Finishes
Ceiling  N/A
Walls  2” thick duct liner board on two adjacent walls, 100% coverage.
Floor  N/A

Mechanical System Design
Noise Criteria  N/A

Notes
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04 | GENERAL GUIDELINES

DOOR CONSTRUCTION

Speech privacy between an enclosed room and a corridor is primarily controlled by the sound barrier performance of the door. Speech privacy design goals for enclosed spaces are achievable only when doors between contiguous spaces are closed.

**Swinging Doors**

Swinging doors provide the best opportunity to control sound transmission. Satisfactory levels of speech privacy can be obtained if solid core wood or hollow metal doors are fitted with standard hinges (butt hinges). In this case, continuous stops may be used at the jambs and head. Pivot hinges are acoustically problematic because they interfere with the use of acoustical seals. As a result, sound leakage occurs at gaps between the door panel and door jamb, head and sill.

The door undercut can usually be limited to 1/4 inch or less, especially if a threshold is used.

If doors (sliding or swinging) are solid glass, use minimum 3/8” thick laminated acoustical glass with manufacturer provided perimeter rubber or brush type gaskets.

**Acoustically Sealed Doors**

Full perimeter sound seals should be used in the most acoustically critical rooms, where confidential speech privacy is required. Please refer to the attached ADI Drawing 01 for details. Assuming Zero International as a basis of design, we recommend the following door seals:

- **Head and Jambs – Model 770**
- **Automatic Door Bottom – Model 369 or 368 (mortised/semi-mortised)**
- **Threshold – Model 164, solid ungrooved. Concrete or wood, or other smooth surface is also acceptable.**
- **Astragal – Model 140**

Note: Some owners do not want automatic door bottom seals for maintenance reasons. Additionally, some thresholds may be identified for elimination due to wear and tear on pianos and other large/heavy instruments. These conditions will be discussed specifically in future phases.

For STC-51/54 doors, please refer to the attached ADI Drawing 02.

For the Studio Theater Door to the crossover, and for the Stage house door to the loading dock, an alternate to swinging STC-54 rated doors are vertical STC-54 doors. Contact Sound Seal and Jamison for details and pricing.

For acoustically critical rooms with isolation expansion joints in the slab at the door, apply the flush expansion joint cover to the scheduled door type, see ADI Drawing 37.
MECHANICAL NOISE CONTROL

SCOPE OF SERVICES

The scope of noise-control services that we will perform includes:

- Preparation of noise control guidelines for the architect and engineers (this report).
- Coordination of noise control guidelines with the architectural, structural, electrical, and mechanical systems designs.
- Review and cooperative revision of contract documents.
- Preparation of noise control specifications for inclusion in contract specifications prepared by the architect and engineers.
- Review of acoustic aspects of contractor submittals.
- Periodic visits to the project site to ensure that noise control components and systems are furnished and installed in accordance with the contract documents.
- Measurement of ambient and intrusive noise levels at completion of the project to confirm that the noise criteria have been met.

Cost-effective noise control is a team effort that requires careful coordination among the entire design team.

SYSTEM DESIGN

There is considerable opportunity at the earliest stages of design to anticipate and avoid noise problems. Careful choice of system type and planning of the locations of noise-producing equipment and noise-sensitive rooms is the most effective and frugal means to control noise.

A concrete roof is recommended underneath the rooftop air handlers.

Noise control requirements depend heavily on the noise produced by the fan itself. Significant savings in noise control costs can be realized simply by selecting quiet and efficient fan equipment. We strongly urge the mechanical engineer to keep this in mind when selecting equipment.

SPACE PLANNING FOR NOISE CONTROL

There is considerable opportunity at the earliest stages of the design to anticipate and avoid acoustic isolation problems. Careful planning of the locations of noise-producing and noise-sensitive equipment and rooms is the most effective and frugal means to control noise. Of particular concern is the type and location of HVAC equipment.
Table 5: Space Planning for Mechanical/Electrical Equipment

<table>
<thead>
<tr>
<th>ITEM</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of Mechanical Equipment</td>
<td>Position the equipment near supporting columns or major beams. Avoid locating in the middle of a span. Do not locate any mechanical equipment directly over or next to any spaces with a background noise criteria less than RC-20. Keep in mind that equipment serving other spaces still generates noise and vibration that can be a problem in noise-sensitive spaces.</td>
</tr>
<tr>
<td>Rooftop Air Handlers</td>
<td>Do not locate air handler units directly above noise-sensitive spaces. Locate as far from acoustically-critical spaces as possible. Units close to acoustically-critical spaces will necessitate heavier upper wall and roof constructions to reduce intrusive noise.</td>
</tr>
</tbody>
</table>

**ROUTING OF DUCTS AND PIPES**

Coordinate the routing of ducts and pipes among the design team and the services engineers at an early design stage.

- Run ducts at least 25 feet between air handlers and noise-sensitive spaces.
- Avoid duct or pipe penetrations in sound isolating constructions.
- Do not route ducts serving noise-sensitive spaces through noise-generating spaces, such as electrical equipment rooms.
- Do not route hot water, chilled water, domestic water, steam and waste pipes through noise-sensitive spaces.
- Route roof drain pipes outside the envelope of noise-sensitive spaces. Avoid running through the roof void above the space. Instead, run the water to the edges where drains can descend outside the room envelope.
- Sprinkler pipes do not create noise. However, where they penetrate, they can compromise noise isolation. Seal airtight where sprinkler pipes penetrate the envelope of any noise-sensitive space.

**MECHANICAL DESIGN REQUIREMENTS FOR NOISE-SENSITIVE SPACES**

This table provides an overview of requirements for the quiet mechanical system required by this project; it should help in budgeting for system.

Table 6: Mechanical System Requirements

<table>
<thead>
<tr>
<th>ITEM</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duct Geometry</td>
<td>Use rectangular ductwork for all ductwork serving noise-sensitive spaces. Use round or oval ductwork for exposed ductwork inside noise-sensitive spaces. Use high aspect ratio ductwork rather than square ducts, but avoid very wide high aspect ratio ducts (above 4:1). External stiffeners may be required for wide ducts. Do not use flexible ductwork to serve noise-sensitive spaces at or below RC-25.</td>
</tr>
<tr>
<td>Duct Lining</td>
<td>Internally line all ductwork serving all noise-sensitive spaces, supply and return, with 1” thick 1.5 pcf density fiberglass duct liner with integral black mat facing from the air-handling units to the air terminals. Line ductwork between supply and return fans, and fan fresh air inlet and exhaust ducts</td>
</tr>
<tr>
<td>ITEM</td>
<td>REQUIREMENT</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
</tr>
<tr>
<td>serving spaces below RC-25.</td>
<td></td>
</tr>
<tr>
<td>Additional thermal insulation is not usually required for fiberglass-lined ducts.</td>
<td></td>
</tr>
<tr>
<td>Fan-noise Attenuators</td>
<td>Budget for an 8’ x 8’ x 8’ plenum and a silencer for both supply and return for each AHU serving performance spaces. (Basis of design: IAC Model LFM).</td>
</tr>
<tr>
<td>Elbows and Turning Vanes</td>
<td>Use full-radius elbows (not mitered elbows) at all spaces below RC-25. Where space for full-radius elbows is not available, consider using small radius elbows. Do not use turning vanes except where required within the mechanical room, or as specifically agreed upon by the acoustics consultant.</td>
</tr>
<tr>
<td>Duct Velocities</td>
<td>Do not exceed velocity requirements described in Table 8 and Table 9 in ducts serving noise-sensitive spaces.</td>
</tr>
<tr>
<td>Duct Terminals</td>
<td>Where required, design the air distribution systems to distribute air properly without the use of diffusers; instead use open-ended ducts. Where some &quot;spreading&quot; of the air is necessary, suspend a plate in front of or below the terminal. Where terminals are acceptable or necessary, select terminal devices with an NC rating of at least 5 dB (preferably 10 dB) less than the recommended NC rating for the space. For terminal conditions for specific spaces, see Table 12.</td>
</tr>
<tr>
<td>Volume Dampers</td>
<td>In spaces where diffusers are not recommended, design the air distribution system to balance without volume dampers. Where volume dampers are necessary, the final section of lined ductwork should be no less than 7 diameters long between outlet and volume damper.</td>
</tr>
<tr>
<td>Return Air openings</td>
<td>Do not use mechanical return air grilles; instead, consider an expanded metal &quot;architectural&quot; product that is at least 85% open area to avoid the potential for rattling, which is common with mechanical grilles.</td>
</tr>
<tr>
<td>Fire Dampers</td>
<td>Locate fire dampers as far from the air terminals as possible. Specify only “out of the air stream” type fire dampers. Do not locate pneumatic thermostats and controls in noise-sensitive spaces. Indicate all fire dampers on the first single-line drawings.</td>
</tr>
<tr>
<td>Smoke Venting</td>
<td>A mechanical smoke venting system is recommended. If a passive smoke venting system is selected, the smoke vents should be specified to have a minimum STC rating of 45.</td>
</tr>
<tr>
<td>Exhaust and Vent Systems</td>
<td>Avoid locating fresh air intakes and exhaust air discharges where they may lead to noise-sensitive outdoor areas or to locations where noise can re-enter the building through walls, windows, doors or vents.</td>
</tr>
<tr>
<td>VAV’s</td>
<td>Where VAV boxes are acceptable, select them with published NC ratings 5 dB lower than room ambient noise level design criterion.</td>
</tr>
<tr>
<td>Penetrations</td>
<td>Seal airtight all duct, pipe, and conduit penetrations of the walls of noise-sensitive spaces, and Mechanical, Electrical and AV Equipment Room walls. See ADI Drawing 07 and 08.</td>
</tr>
</tbody>
</table>

**REQUIRED INFORMATION FROM MECHANICAL ENGINEER**

To perform the necessary review of the mechanical system design, we require the following information listed in Table 7.
Table 7: Initial Information Required from the Mechanical Engineer

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION/COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equipment Sound Power</strong></td>
<td>Manufacturers’ sound power levels by octave-band for all mechanical equipment serving noise-sensitive spaces. This information is typically available directly through the manufacturer or their local representative. If sound power data are not available, provide fan type, size, airflow quantity, total static pressure, motor horsepower, brake horsepower, rpm, and number of blades for each fan unit serving noise-sensitive spaces.</td>
</tr>
<tr>
<td><strong>Duct Distribution Drawings</strong></td>
<td>Duct sizes. Extent and type of lining including thickness and density. Air quantities in each duct. Diffuser types and air quantity through each diffuser or grille. Ductwork construction.</td>
</tr>
<tr>
<td><strong>Equipment Locations</strong></td>
<td>Equipment locations, structural bay dimensions, slab thickness.</td>
</tr>
<tr>
<td><strong>Air Terminal Devices</strong></td>
<td>Operating characteristics, including airflow adjustment technique, make/model of devices</td>
</tr>
</tbody>
</table>

**AIR VELOCITIES**

For performance, rehearsal, and recording spaces, design return-air openings as bare architectural or duct openings. If over-sized, the return-air openings may have grilles of at least 65% open area (e.g., “egg crate”).

Table 8: Maximum Duct Air Velocities (fpm) for Bare Duct Openings or Plaque Diffusers

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply and return main ducts outside of space</td>
<td>1200</td>
<td>1300</td>
<td>1400</td>
<td>1500</td>
<td>1600</td>
</tr>
<tr>
<td>Main supply and return ducts within space (including above ceilings) if more than 25’ from air openings</td>
<td>900</td>
<td>950</td>
<td>1000</td>
<td>1050</td>
<td>1100</td>
</tr>
<tr>
<td>Branch supply and return ducts within 25’ of air openings</td>
<td>700</td>
<td>750</td>
<td>800</td>
<td>850</td>
<td>900</td>
</tr>
<tr>
<td>Terminal supply ducts</td>
<td>600</td>
<td>650</td>
<td>700</td>
<td>750</td>
<td>800</td>
</tr>
<tr>
<td>Return air openings</td>
<td>500</td>
<td>550</td>
<td>600</td>
<td>650</td>
<td>700</td>
</tr>
</tbody>
</table>

We do not recommend the use of flexible ducts and diffusers in noise-sensitive spaces. If this cannot be avoided, Table 9 lists the maximum allowable air velocities.

Table 9: Maximum Duct Air Velocities (fpm) for Flexible Ducts and Rated Diffusers

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Branch supply/return ducts, within 25 feet of air openings</td>
<td>400</td>
<td>450</td>
<td>500</td>
<td>550</td>
<td>600</td>
</tr>
<tr>
<td>Terminal ducts within 7 duct diameters of air openings</td>
<td>300</td>
<td>350</td>
<td>400</td>
<td>450</td>
<td>500</td>
</tr>
<tr>
<td>Return grills up to 10 diameters from inlet</td>
<td>350</td>
<td>400</td>
<td>450</td>
<td>500</td>
<td>550</td>
</tr>
</tbody>
</table>
### DEDICATED AIR-HANDLING SYSTEMS

#### Table 10: Spaces Requiring Dedicated Air-handling systems

<table>
<thead>
<tr>
<th>ROOM</th>
<th>AIR-HANDLING SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auditorium, Recital Hall, Studio Theatre, Choir Rehearsal, Large Instrumental Rehearsal</td>
<td>Dedicated constant volume system for each space.</td>
</tr>
<tr>
<td>Dimmer rack room</td>
<td>VAV system; Locate VAV boxes in adjacent corridors, not over acoustically-critical spaces.</td>
</tr>
<tr>
<td>Control Booths</td>
<td>VAV system; Locate VAV boxes in adjacent corridors, not over acoustically-critical spaces.</td>
</tr>
<tr>
<td>Sound and Light Locks</td>
<td>No supply or return air required, only transfer ducts.</td>
</tr>
</tbody>
</table>

### MECHANICAL EQUIPMENT SELECTION

#### Table 11: Mechanical Equipment Selection

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION/COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fans</td>
<td>Use Class I built-up centrifugal fans, with backward-inclined airfoil blades. Select and balance for maximum efficiency. Axial and forward-curved centrifugal fans acceptable in some circumstances.</td>
</tr>
<tr>
<td>Pumps</td>
<td>Select and balance for maximum efficiency. The diameter of a pump impeller should not exceed 80% of the pump’s inside case diameter, as measured on a line through the cutwater and center of rotation.</td>
</tr>
<tr>
<td>Drinking</td>
<td>Do not locate chilled drinking fountains on walls common to noise-sensitive spaces. Mount the cooler on vibration isolators.</td>
</tr>
</tbody>
</table>

#### Table 12: Air Terminal Conditions for Noise-Sensitive Spaces

<table>
<thead>
<tr>
<th>SPACE</th>
<th>AIR TERMINAL CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance/rehearsal spaces</td>
<td>Open-ended ducts discharging horizontally, or discharging vertically with plates suspended below the duct opening.</td>
</tr>
<tr>
<td>smaller practice rooms, offices</td>
<td>Standard diffusers, with provisions as described above. Select units known to not be susceptible to rattling during loud music.</td>
</tr>
<tr>
<td>Sound and light locks (SLLs)</td>
<td>SLLs should have no supply/return. Incorporate a 1 ft² lined transfer duct between the SLL and the room they serve so the doors close easily. See ADI Drawing 09.</td>
</tr>
</tbody>
</table>

### EQUIPMENT SUPPORT

- Mount or suspend all rotating and reciprocating equipment using suitable vibration isolation devices.
- Connect piping with resilient connections and isolate from the building structure by mounting or hanging from suitable vibration isolation devices.
• Locate vibration isolation mounts directly on the building structure where possible. Avoid direct support from lightweight slabs or roof decks, and avoid seating isolation mounts on steel frame sub structures.

| ROOFTOP AIR HANDLERS |
These recommendations apply to all roof-to air-handlers in the building, not just those serving noise-sensitive spaces.
- Position rooftop equipment near supporting columns or major beams.
- Minimize roof spans to make the supporting structure as stiff as possible. It may be necessary to frame between major beams for additional stiffness to improve the isolation efficiency of vibration isolators.
- Mount vibration isolation mounts directly on the building structure where possible. Align through the cutwater and center of rotation.

| HOUSEKEEPING PADS |
Support indoor mechanical equipment (including pumps, compressors, and fan units) on suitable vibration isolators that, in turn, bear on 4” thick concrete housekeeping pads. Size the pad area to extend beyond the supported mechanical unit plus its vibration isolators.

| PIPE CONNECTIONS |
- Connect pipes to all vibration-isolated equipment with special flexible connectors, including air-handlers.
- Support all HVAC and plumbing pipes with spring-and-neoprene isolators having the same static deflection as the equipment to which the pipes are connected, within 10 pipe diameters of rotating equipment.
- Pipes connected to other vibrating equipment are usually considered on an individual basis when noise control specifications are developed. Some form of flexible connection and/or resilient support is often required.
- Pipes connected to boilers, condensers, cooling towers, etc., are usually considered on an individual basis when noise control specifications are developed. Some form of flexible connection and/or resilient support is often required.

| ELECTRICAL CONNECTIONS TO MECHANICAL EQUIPMENT |
Make electrical connections to all vibration isolated equipment including pumps, fans and transformers with flexible conduit, not less than 3’ in length, and installed in a complete 360° loop or slack U-shape.

| DUCT CONNECTIONS |
Connect all ductwork to fans, fan casings or fan plenums with flexible sleeves. Install each sleeve with at least 7 inches slack across a clear metal-to-metal gap of at least 4 inches. The purpose of these sleeves is to prevent the short circuiting of the fan isolation and to interrupt the transmission of vibration via the duct wall.
| ELEVATOR EQUIPMENT |
Isolate hydraulic equipment, including piping, from the building structure using neoprene mountings.
Install a hydraulic muffler.

For electric systems, mount the motor-generator sets (and hoist motors and pulley supports for some systems) on neoprene isolators. Such isolation is usually packaged by the manufacturer, but the engineer should be aware that it may be optional and will need to be included in the specifications.

06| PLUMBING NOISE CONTROL |
| ROOF DRAINS |
All roof drain piping should be routed outside the envelope of performance spaces. However, in the event that exposed roof drain piping cannot be re-routed outside these spaces, they should be wrapped with mass loaded vinyl.

07| ELECTRICAL NOISE CONTROL |
| TRANSFORMERS |
• Locate transformers on grade, remote from noise-sensitive spaces, and mount on spring-type vibration isolators, with flexible conduit connections. Smaller transformers (under 75 KVA) may be located above grade if in a part of the building that is structurally isolated from the noise-sensitive spaces.
• Mount all transformers on vibration isolators.

| SMALL TRANSFORMERS, RELAYS, AND MOTORS |
• Do not install clocks, controls and other small equipment controls that contain small transformers, relays, or motors in noise-sensitive spaces.
• Do not specify equipment such as studio clocks, electrical or magnetic door closers, hold-open and security devices for noise-sensitive spaces.
• Do not locate relays in noise-sensitive spaces.

| THEATRICAL LIGHTING SYSTEM DIMMER ROOM |
Location
• Do not route cables directly from a dimmer room into performance spaces.

Dimmer Noise and Vibration Isolation
• Mount dimmer racks on neoprene-steel sandwich pads.
• Attach conduit with flexible connections and separate flexible ground wires to isolate their vibration from the surrounding structure.
• Avoid rigid contact or connections between dimmer rack conduits and walls and slabs common to the performance spaces.
THEATRICAL AND ARCHITECTURAL LIGHTING SYSTEM DIMMERS

Assuming that SCR type dimmers are planned, select the quietest house and production lighting dimmers that the budget can afford. As a minimum, select house and production lighting dimmers that can achieve a rise time of not less than 350 microseconds.

Higher rise time dimmers can add considerably to the cost, and with only some additional benefit as it relates to reducing filament buzzing noise. A more cost-effective approach is to ensure that each dimmer be loaded to at least 80% of full rated load, and preferably 100% of full rated load. Consider this element in designing the dimmed architectural lighting circuiting.

There are a number of new dimming technologies under development. These should be explored as an alternative means of providing dimming with minimal noise impact. This exploration will require coordination with the theatre consultant.

A key determinant of the amount of lighting noise, more so than dimmer selection and loading, is fixture selection. Guidelines are provided below.

LIGHTING FIXTURE SELECTION FOR LOW NOISE

In general, only incandescent lighting systems should be used in the performance spaces, except for lighting systems such as work lights which are not in use during services performances or rehearsals.

Select house and performance lighting fixture lamps for low noise. In general, sources should be halogen or quartz sources rather than “A” lamps. A lamps of 100 watts or less are generally quiet, but higher wattage A lamps are very prone to filament buzzing noise. PAR lamps are acceptable up to 750 watts.

FLUORESCENT AND LED LIGHTING

The goal for reducing energy costs increases the pressure on projects to consider fluorescent and LED sources instead of incandescent sources. There can be significant challenges with respect to the ability to dim these fixtures all the way off; these issues should be discussed with the theatre consultant. With respect to noise concerns, these alternative fixtures do not create any filament buzz; however they often require ballasts/transformers/power supplies that cannot be located remotely outside the noise critical space. These ballasts/transformers/power supplies may generate unacceptable levels of noise and, when they cannot be located remotely outside the noise critical space, should be tested for noise prior to approval.

Do not use utility type SCR dimmers or fixtures used by SCR dimmers for standard lighting in Control rooms where the high levels of RF output may cause interference with the building audio systems. Use autotransformer or solid state dimming modules which provide a clean electrical output.

BALLASTS

Use integrated circuit electronic type ballasts for fluorescent lighting, or else locate remotely from noise-sensitive spaces. Simply specifying “Type A” ballasts will not necessarily be sufficiently quiet. Some ballasts we have tested and find acceptable for this use are:

- Sylvania QTP2x32TB/UNV PSN-TC
- Advance IIC-2S32-SC
EXIT SIGNS, AISLE LIGHTS

Exit signs, aisle lights and fire annunciators in performance spaces should be self-powered or incandescent. They should not contain relays, transformers or contactors, and must not be fluorescent. Incandescent 120V fixtures are acceptable. Low voltage fixtures may be acceptable if all are fed by a common transformer located outside of noise-sensitive spaces.

EMERGENCY LIGHTING AND POWER

Do not use emergency lighting in performance spaces that contains integral batteries, ballasts or transformers. Do not locate contactors for emergency lighting fixtures in performance spaces. Such relays are “normally on” and can generate disturbing hum.

END OF REPORT
NOTES:
1. PROVIDE FIRE RATED ASSEMBLY AS REQUIRED. 2. DO NOT RUN CARPET THROUGH DOOR OPENING.
3. COORDINATE HARDWARE WITH DOOR SEALS. SEALS TO BE CONTINUOUS. DO NOT CUT OR MODIFY SEALS FOR ANY REASON. 4. ALL FLEXIBLE SOUND SEALS MUST NEVER BE PAINTED, UNDER ANY CIRCUMSTANCE, AS THIS WILL RENDER THEM INEFFECTIVE. 5. BLOCK WALL CONSTRUCTION: FILL FRAME W/ GROUT. GWB WALL CONSTRUCTION: FILL FRAME WITH 5.8 DENSITY MINERAL WOOL.
NOTES:
1. PROVIDE FIRE RATED ASSEMBLY AS REQUIRED.
2. DO NOT RUN CARPET THROUGH DOOR OPENING.
3. COORDINATE HARDWARE WITH DOOR SEALS. SEALS TO BE CONTINUOUS. DO NOT CUT OR MODIFY SEALS FOR ANY REASON.
4. BLOCK WALL CONSTRUCTION: FILL FRAME W/ GROUT. GWB WALL CONSTRUCTION: FILL FRAME WITH 2.5 DENSITY MINERAL WOOL.
NOTE:
1. NO BRACING BETWEEN STUDS

1/2" THICK CLOSED CELL NEOPRENE
6'-0" AFF
STEEL ANGLE
3/8" LAMINATED GLASS
1" THICK BLACK FABRIC WRAPPED FIBERGLASS PANEL
3'-0" AFF
ROUGH WOOD FRAMING

SCHEDULED PARTITON
CONTINUOUS STEEL ANGLE
1/8" CONTINUOUS CLOSED CELL NEOPRENE GLAZING CHANNEL
1/8" CONTINUOUS CLOSED CELL NEOPRENE GLAZING CHANNEL
3/8" LAMINATED GLASS
1" HARDWOOD REMOVABLE BLOCKING
1/2" TRIM
2" THICK PRE-FABRICATED ACOUSTICAL WALL PANELS; 6-PCF DENSITY

BLOCKING / FRAMING AS REQ'D TO SUPPORT PANEL

WRAP FABRIC AROUND ALL EDGES AND 3" ONTO BACK OF PANEL

SCHEDULED PARTITION

MOLDING
NOTE:
1. CROSS-LAY ALL MULTIPLE LAYERS OF GWB.
2. DO NOT LAY ONE SEAM DIRECTLY OVER THE ONE BENEATH.
6" STEEL JOIST, GAGE, SPACING, AND MOUNTING TO BE REVIEWED BY STRUCTURAL ENGINEER

6" FIBERGLASS OR MINERAL WOOL BATT INSULATION, 2.5 PCF

CAULK ENTIRE PERIMETER
ALL SIDES TIGHT

12" PREFERRED
6" MIN

RETURN AIR

FINISHED CEILING

FLEX DUCT PERMITTED
BELOW SOUND BARRIER CEILING

PLATE DIFFUSER

SCHEDULED PARTITION

SCHEDULED PARTITION

CORRIDOR

FACULTY STUDIO / PRACTICE ROOM

FACULTY STUDIO / PRACTICE ROOM

EXPANSION JOINT

EXPANSION JOINT

DUCT OR CONDUIT PENETRATION (TYP.)
NOTES:
1. SUPPORT DUCT, PIPE OR CONDUIT TO PREVENT CONTACT WITH PARTITION.
2. NO TAPE OR COMPOUND BRIDGING BETWEEN GWB AND DUCT, PIPE, OR CONDUIT.

PACK FULL DEPTH WITH FIBERGLASS OR MINERAL FIBER BATT

CONTINUOUS BEAD OF CAULK ON POLYETHYLENE FOAM ROD AROUND ENTIRE PERIMETER OF DUCT BOTH SIDES OF WALL

DUCT, CONDUIT, OR PIPING PENETRATION
NOTES:
1. SUPPORT DUCT, PIPE OR CONDUIT TO PREVENT CONTACT WITH PARTITION.
2. NO MORTAR BRIDGING BETWEEN CMU AND DUCT, PIPE, OR CONDUIT.

- SCHEDULED PARTITION
- PACK FULL DEPTH WITH FIBERGLASS OR MINERAL FIBER BATT
- CONTINUOUS BEAD OF CAULK ON POLYETHYLENE FOAM ROD AROUND ENTIRE PERIMETER OF DUCT BOTH SIDES OF WALL
- DUCT, CONDUIT, AND PIPING PENETRATION
- 3/8" - 1" STEEL SLEEVE
- GROUT SOLID AROUND OUTER SLEEVE SUPPORT
NOTE:
1. SIZE DUCT AND OPENINGS FOR 500-FPM.
FINISHED ACT CEILING

ALL PENETRATIONS THRU SOUND ISO.CLG WILL NEED TO BE SEALED WITH NON-HARDENING ACOUSTIC CAULK

NOISE-SENSITIVE SPACE

EXPANSION JOINT

SCHEDULED PARTITION

3 LYRS. 5/8" THICK GWB

2 LYRS. OF 2" THICK MINERAL WOOL BATT INSULATION

ACOUSTIC DISTINCTIONS
145 Huguenot Street
New Rochelle, NY 10801
Tel: (914) 712-1300 Fax: (914) 712-1301

SUBJECT: Isolated Joist Ceiling
PROJECT: East Tennessee State University Performing Arts Center
DATE: 10/21/2015
SCALE: 1/2" = 1'-0"
PROJECT #: 2015160

2015160
NEOPRENE SPRING HANGER ISOLATORS

2 LYLES. 5/8" THICK GWB

2 LYLES. OF 2" THICK MINERAL WOOL BATT INSULATION

ALL PENETRATIONS THRU SOUND ISO.CLG WILL NEED TO BE SEALED WITH NON-HARDENING ACOUSTIC CAULK

NOISE-SENSITIVE SPACE

FINISHED ACT CEILING

SCHEDULED PARTITION

EXPANSION JOINT

CAULK (TYP)

3/4" MW BATT INSULATION

1/2" THICK CLOSED CELL NEOPRENE

1" THICK CLOSED CELL NEOPRENE

3"X3" STEEL ANGLES (TYP)
NOTE:
1. SEPERATE BOXES ON OPPOSITE SIDES OF THE WALL BY 16" MINIMUM.
NOTE:
1. SEPERATE BOXES ON OPPOSITE SIDES OF THE WALL BY 16" MINIMUM.
NOTE:
1. CROSS-LAY ALL MULTIPLE LAYERS OF GWB
2. DO NOT LAY ONE SEAM DIRECTLY OVER THE ONE BELOW
NOTE:
1. CROSS-LAY ALL MULTIPLE LAYERS OF GWB
2. DO NOT LAY ONE SEAM DIRECTLY OVER THE ONE BENEATH
Partition Type PD-33

East Tenn State U PAC

01/28/2016 1-1/2" = 1'-0" 2015160

3 LAYERS 5/8" GWB

3" MINERAL WOOL BATT

1" AIRSPACE

3-5/8" METAL STUD

3-5/8" METAL STUD

3 LAYERS 5/8" GWB

3" MINERAL WOOL BATT

3" MINERAL WOOL BATT
NOTES:
1. CROSS-LAY MULTIPLE GWB LAYERS; JOINTS IN ULTIMATE-LAYER ASSEMBLY SHALL NOT BE LAID DIRECTLY OVER EACH OTHER.
2. DO NOT BRIDGE BETWEEN STUDS.
NOTES:
1. CROSS-LAY MULTIPLE GWB LAYERS; JOINTS IN MULTIPLE-LAYER ASSEMBLY SHALL NOT BE LAID DIRECTLY OVER EACH OTHER.
2. DO NOT BRIDGE BETWEEN STUDS.
ACOUSTIC DISTINCTIONS

SUBJECT: Isolation Booth Elevator Wall

PROJECT: East Tennessee State U PAC

DATE: 01/29/2016
SCALE: 1-1/2" = 1'-0"
PROJECT #: 2015160

FINISH CEILING

KINETICS UNIBRACE

ISOLATION BOOTH

ELEVATOR

2 LAYERS 5/8" GWB

2 1/2" STUD 12" O.C.

3" MINERAL WOOL 2.5 PCF

1-1/2" AIR SPACE

BASE

CAULK (TYP.)

KINETICS WALLMAT (TYP.)
NOTES:
1. CROSS-LAY MULTIPLE GWB LAYERS; JOINTS IN MULTIPLE-LAYER ASSEMBLY SHALL NOT BE LAID DIRECTLY OVER EACH OTHER.
2. DO NOT BRIDGE BETWEEN STUDS.
FLOOR ISOLATION JOINT

3-5/8" METAL STUD

3" MINERAL WOOL BATT

3 LAYERS 5/8" GWB

PERCUSSION

CORRIDOR 1100D

1/2"

1/4" THICK CLOSED CELL FOAM SEALANT (SAINT-GOBAIN MODEL 'NORSEL V738' OR APPROVED EQUAL); STRIP SHOULD BE INSTALLED VERTICALLY CONTIGUOUS THROUGHOUT PARTITION

FLOOR ISOLATION JOINT

L-BEAD (TYP)

TAPE & SPACKLE

EXISTING ISOLATION CUT IN CMU WALL

FILL ENTIRE ISOLATION CUT WITH NON-HARDENING PAINTABLE ACOUSTIC CAULK

BACKER ROD

PERCUSSION

PERCUSSION

PERCUSSION
6" grout filled CMU, no rigid connection to 8" CMU on other side of air gap

1" isolation cut in slab around Studio Theatre perimeter, aligned in 4" air gap at this double wall, air gap runs full two-story height
Recital Hall - Piano Duet Musician Layout
East Tenn State U PAC
01/13/2017 3/16" = 1'-0" 2015160

PERFORMANCE PLATFORM
104E 491.96 SF

ACOUSTIC DISTINCTIONS
60 East 42nd Street
New York, NY 10165
Tel: 212.764.0218

SUBJECT: Recital Hall - Piano Duet Musician Layout
PROJECT: East Tenn State U PAC
DATE: 01/13/2017
SCALE: 3/16" = 1'-0" PROJECT #: 2015160
Recital Hall - 23 Piece Chamber Orchestra with Harpsichord Layout

East Tenn State U PAC

16'-9"

12 VIOLIN
4 VIOLA
4 CELLO
2 BASS
1 HARPSICORD
23 PIECE TOTAL

PERFORMANCE PLATFORM
104E 491.96 SF
Instrumental Room - 75 Piece Orchestra + Steinway B Piano Layout

ACOUSTIC DISTINCTIONS
60 East 42nd Street
New York, NY 10165
Tel: 212.764.0218

SUBJECT: Instrumental Room - 75 Piece Orchestra + Steinway B Piano Layout
PROJECT: East Tenn State U PAC
DATE: 01/13/2017
SCALE: 1/8" = 1'-0"
PROJECT #: 2015160
DIVA Ceiling elements to extend the entire square footage of the stage house, so that, when fully deployed they block all soft goods above and create a reverberation chamber in the stage wings below.

Reflector Ceiling Elements ranging in size from: 6' x 8' to 14'-6" x 8', Configuration symmetric on long axis of room, but with varied spacing from 1'-6" to 5' between elements in a row. Some rows odd number of reflectors, some rows even.
Performance Hall Platform - 60pc Ensemble
East Tennessee State University PAC

60' wide proscenium
60 musician ensemble
(8) 10' wide collapsible orchestra shells

60' wide platform
35'-5" WIDE PROSCENIUM

ACOUSTIC DISTINCTIONS
60 East 42nd Street
New York, NY 10165
Tel: 212.764.0218

SUBJECT: Performance Hall Platform - 60pc Ensemble
PROJECT: East Tennessee State University PAC
DATE: 10/12/2015
SCALE: NTS
PROJECT #: 2015160
Performance Hall Platform - 80pc Ensemble
East Tennessee State University PAC

60' WIDE PROSCENIUM
80 MUSICIANS' ENSEMBLE
(8) 10' WIDE COLLAPSIBLE ORCHESTRA SHELLS
ACOUSTIC DISTINCTIONS
60 East 42nd Street
New York, NY 10165
Tel: 212.764.0218

SUBJECT: Expansion Joint Cover at acoustic door for easy piano transportation

PROJECT: East Tenn State U PAC
DATE: 01/13/2017
SCALE: 3" = 1'-0" PROJECT #: 2015160

ACOUSTIC DOOR

AUTOMATIC DOOR SEAL

3/8" STEEL PLATE SHIMMED FLUSH & FLAT

1/4" x 1 1/2" x 50" DURO NEOPRENE STRIP

1/2" GAP (MAXIMUM)

JOINT COVER EXTRUSION

CONCRETE CURB

2" ACOUSTIC JOINT IN STRUCTURE STUFFED WITH GLASS FIBER, SEALED ENDS
D1  DOOR WITH SOUND SEALS, NO LATCHING HARDWARE
D2  DOOR WITH SOUND SEALS, WITH LATCHING HARDWARE
D3  STC-51 RATED DOOR
D4  STC-54 RATED DOOR

PS22 (SEE DRAWING 18)
PS33 (SEE DRAWING 19)
PD22 (SEE DRAWING 20)
PD33 (SEE DRAWING 21)
M8 (8" SOLID MASONRY)
M8-2 (SEE DRAWING 25)
MD8-22 OTHERWISE (DWG. 22)
M10-2 (SEE DRAWING 25)
M12 (12" SOLID MASONRY)
M12-2 (SEE DRAWING 25)
PLUMBING WALL (DRAWING 23)
EXTERIOR BRICK VENEER + 2 3/8"
AIRSPACE + SCHEDULED
MASONRY (8" FOR STUDIO THEATRE,
10" FOR RECITAL, 12" FOR
AUDITORIUM)

8" GROUT FILLED CMU + 4" AIR GAP
+6" GROUT FILLED CMU (NO RIGID
CONNECTION ACROSS AIRGAP
BETWEEN THE 2 CMU SIDES. 6" is
SCENE SHOP SIDE, SEE ADI
DRAWING 27.)
D1 DOOR WITH SOUND SEALS, NO LATCHING HARDWARE
D2 DOOR WITH SOUND SEALS, WITH LATCHING HARDWARE
D3 STC-51 RATED DOOR
D4 STC-54 RATED DOOR

PS22 (SEE DRAWING 18)
PS33 (SEE DRAWING 19)
PD22 (SEE DRAWING 20)
PD33 (SEE DRAWING 21)
M8 (8" SOLID MASONRY)
M8-2 (SEE DRAWING 25)
M8-2-2 OTHERWISE (DWG. 22)
M10-2 (SEE DRAWING 25)
M12 (12" SOLID MASONRY)
M12-2 (SEE DRAWING 25)
PLUMBING WALL (DRAWING 23)
EXTERIOR BRICK VENEER + 2 3/8" AIRSPACE + SCHEDULED MASONRY (8" FOR STUDIO THTRE, 10" FOR RECDITAL, 12" FOR AUDITORIUM)

8" GROUT FILLED CMU + 4" AIR GAP +6" GROUT FILLED CMU (NO RIGID CONNECTION ACROSS AIRGAP BETWEEN THE 2 CMU SIDES. 6" is SCENE SHOP SIDE, SEE ADI DRAWING 27.)
FLOATING FLOOR SLAB WITH 1" ACOUSTIC ISOLATION (EXPANSION) JOINT

If the mechanical assembly has air handlers, no floating floor required, just appropriate spring and neoprene vibration isolators. If there are other kinds of equipment, pumps, etc, a floating floor will be required.
ETSU FINE ARTS BUILDING

DIVISION 27 AV SYSTEMS & RELATED INFRASTRUCTURE
DESCRIPTIONS & STATEMENT OF PROBABLE COST
100% DD UPDATE 2017.03.13

I. PUBLIC LOBBY

Spaces include: Main Lobby; Public Restrooms; Box Office.
The installed systems consist of the following major components.

1. ZONED LOUDSPEAKER SYSTEM
   A. Program sound, live pages and announcements from the Main Auditorium, Recital Hall, and Studio Theater, pre-recorded messages and chimes may be routed as required to loudspeakers in the Main Lobby adjacent to the performance spaces.

2. VIDEO
   A. Show relay video from the performance spaces and video from other discrete sources is fed to video displays in the Main Lobby area.

3. BOX OFFICE
   A. Program sound from the three performance spaces is available in the Box Office area on local loudspeakers.

4. AV EQUIPMENT HUBS
   A. Additional AV equipment, required to interface all of the above systems, is located in the Auditorium Sound Rack Room.
   B. The equipment installed in these locations includes: signal processing, amplifiers, plug boxes, patch bays, cable assemblies, video monitors, racks, computers, and other infrastructure.
   C. A computer-based system allows remote monitoring, control, and diagnostic testing of the AV system. In addition, this system stores default presets, settings, and programs, and can be used to address most of the AV processing devices.

5. ESTIMATED COST OF INSTALLED AV EQUIPMENT LISTED ABOVE ....... $35,000
II. MAIN AUDITORIUM

Spaces include: Auditorium; Orchestra Pit; Control Rooms; Dressing Rooms; Green Room.
The installed systems consist of the following major components.

1. SOUND REINFORCEMENT SYSTEMS

   Loudspeaker arrays framing the proscenium provide the majority of sound reinforcement for all seats.

   A. Side loudspeaker arrays, one each at stage left and stage right, are permanently mounted above and just downstage of the stage lip. These arrays work in conjunction with the center array to provide imaging and performer localization for low-level reinforcement and announcements associated with low-volume events.

   B. A center loudspeaker array is suspended above and downstage of the stage lip. This array provides primary voice reinforcement.

   C. Larger, tour-friendly loudspeaker systems will be included as an alternate in the contract documents. (These are not included in the cost estimate at the end of this section.)

2. SUPPLEMENTAL SOUND REINFORCEMENT SYSTEMS

   A complement of supplemental reinforcement loudspeakers provides additional coverage and intelligibility to seats that are out of range of the primary loudspeaker arrays.

   A. The first few rows of the orchestra-level seating are covered by small portable loudspeakers that can move from the stage edge to the pit rail, depending on show requirements.

   B. Seats at the rear of the orchestra-level seating are covered by small time-delayed loudspeakers integrated into the under-balcony ceiling.

   C. Seats at the rear of the balcony are supplemented by a time delayed loudspeakers suspended under the mid-house catwalk.

3. EFFECTS/MONITOR SYSTEM

   A. Spatial sound effects, stage monitors, and other requirements are accommodated by a patching system, loudspeaker plug boxes on stage and in the auditorium, and additional portable equipment.

4. FOH MIXING & PLAYBACK EQUIPMENT

   A. A sixty-four input digital mixing console combines signals from live microphones, prerecorded material, and audio special effects. These signals can then be assigned through a matrix to any of the loudspeaker systems located throughout the performance hall.

   B. A complement of AV sources, appropriate to program needs is provided, including a compact flash recorder and a Blu-ray player.
5. ADA COMPLIANT AUDIO SYSTEM  
   A. This system transmits stage sound or other selected program material, by means of infrared light to individual receivers provided for the hearing impaired.  
   B. The ADA system can also be used for transmission of narration and stage sound or other selected program material to individual receivers provided for the sight impaired.  

6. INTERCOM SYSTEM  
   A. The technical intercom system supplies four channels of two-way communication among technical operating personnel through wired and wireless belt packs connected to headsets with boom-mounted microphones. Plug boxes or stations are provided for all technical operating positions in the stage, house, control booths, and other key areas.  

7. MICROPHONES  
   A. A complement of wired and wireless microphones, stands, cables, adapters, and accessories, appropriate to program needs, is provided.  

8. AV DISTRIBUTION AND CONTROL  
   A. A video network receives video signals the stage area, control booth, FOH Mix Position, or other connection panels located throughout the venue. These sources are distributed to projectors, flat panel displays, recorders, and other devices as needed.  
   B. A small touch panel provides access to video signal routing matrices and preset assignments.  
   C. A network switch connects video sources for control.  

9. VIDEO PROJECTION  
   A. A 3-DLP HD video projector provides for projection of video sources. The primary projection location is the upstage wall, but optional connections will be available in the control booth and follow-spot booth.  

10. PROJECTION SCREENS  
    A. A fixed frame projection screen is flown from a rigging lineset in the stagehouse.  

11. AV CAPTURE & STREAMING  
    A. An AV capture system allows stereo audio and HD video to be recorded locally to a disc-based recording system, stored via network server, and/or streamed live.  
    B. These signals can be interfaced with a third party network server with asset management software.
12. AV EQUIPMENT HUBS
   A. Additional AV equipment, required to interface all of the above systems, is located
      in the Main Auditorium Sound Rack Room.
   B. The equipment installed in these locations includes: signal processing, amplifiers,
      plug boxes, patch bays, cable assemblies, video monitors, racks, computers, and
      other infrastructure.
   C. A computer-based system allows remote monitoring, control, and diagnostic
      testing of the AV system. In addition, this system stores default presets, settings,
      and programs, and can be used to address most of the AV processing devices.

13. TERMINATIONS & CABLE INTERFACE
   A. Plug boxes and terminations are located throughout the stage and auditorium and
      provide hardwire connectivity for AV signal transport among the various locations.
   B. Most AV signals terminate in equipment racks where signals can be routed to
      various destinations via patch bays and patch cables.
   C. A variety of cable assemblies interface AV equipment with the infrastructure.

14. POWER DISTRIBUTION SYSTEM
   A. Backup-UPS’s are included for equipment protection and proper shutdown in the
      event of a power failure.

15. ESTIMATED COST OF INSTALLED AV EQUIPMENT LISTED ABOVE ..... $450,000

III. STUDIO THEATER

Spaces include: Theater; Control Room; Dressing Rooms (2); Green Room

To accommodate the flexible nature of the space and variety of programming, the Audio and
Video systems are designed to a large degree to be portable and configurable. Base systems
consist of the following major components:

1. SOUND REINFORCEMENT SYSTEM
   A. A basic complement of portable loudspeakers and associated amplifier/controllers
      is provided and can be configured for use as primary reinforcement, theatrical
      sound effects and soundtrack playback, performer/presenter stage monitors, etc.
   B. A patching system, loudspeaker plug boxes on the gallery level and in the theater,
      and a complement of rigging hardware facilitates flexible deployment of these
      systems.

2. MIXING & PLAYBACK EQUIPMENT
   A. A thirty-two input digital mixing console combines signals from live microphones,
      prerecorded material, and audio special effects. These signals can then be
      assigned through a matrix to any of the loudspeaker systems located throughout
      the performance hall.
B. A complement of AV sources, appropriate to program needs is provided, including: Blu-ray player, compact flash recorder, compact disc recorder with iPod dock, and PTZ cameras.

3. ADA COMPLIANT AUDIO SYSTEM
   A. This system transmits stage sound or other selected program material, by means of radio frequency to individual receivers provided for the hearing impaired.
   B. The ADA system can also be used for transmission of narration and stage sound or other selected program material to individual receivers provided for the sight impaired.

4. INTERCOM SYSTEM
   A. The technical intercom system supplies four channels of two-way communication among technical operating personnel through wired and wireless belt packs connected to headsets with boom-mounted microphones. Plug boxes or stations are provided for all technical operating positions in the stage, house, control booths, and other key areas.

5. MICROPHONES
   A. A complement of wired and wireless microphones, stands, cables, adapters, and accessories, appropriate to program needs, is provided.

6. AV DISTRIBUTION AND CONTROL
   A. A video network receives video signals the stage area, gallery or control booth. These sources are distributed to portable projectors, flat panel displays, recorders, and other devices installed on a per-show basis, as needed.
   B. A small touch panel provides access to video signal routing matrices and preset assignments.
   C. A network switch connects video sources for control.

7. AV EQUIPMENT HUBS
   A. Additional AV equipment, required to interface all of the above systems, is located in the Control Booth.
   B. The equipment installed in these locations includes: signal processing, amplifiers, plug boxes, patch bays, cable assemblies, video monitors, racks, computers, and other infrastructure.
   C. A computer-based system allows remote monitoring, control, and diagnostic testing of the AV system. In addition, this system stores default presets, settings, and programs, and can be used to address most of the AV processing devices.
8. TERMINATIONS & CABLE INTERFACE
   A. Plug boxes and terminations are distributed around the gallery and theater level and provide hardwire connectivity for AV signal transport among the various locations.
   B. Most AV signals terminate in equipment racks where signals can be routed to various destinations via patch bays and patch cables.
   C. These connections also facilitate the use of additional AV equipment from the Portable AV Equipment Pool (see IX) for additional capacity.
   D. Broadcast Supply Panels provide fiber and data connection to the Recording Facility and remote Broadcast Control Room.
   E. A variety of cable assemblies interface AV equipment with the infrastructure.

9. POWER DISTRIBUTION SYSTEM
   A. Backup-UPSs have been included for equipment protection and proper shutdown in the event of a power failure.

10. ESTIMATED COST OF INSTALLED AV EQUIPMENT LISTED ABOVE ..... $200,000

IV. RECITAL HALL
Spaces include: Auditorium; Control Booth; Green Room.
The installed systems consist of the following major components.

1. LOUDSPEAKERS
   A. Two low profile wall mounted loudspeakers on the left and right side walls near the stage lip provide sound for pre-recorded messages, live announcements, presentations, and light reinforcement.
   B. Two small sub-woofer cabinets are mounted under the stage and operate in conjunction with the main system to add warmth and power for music programs.
   C. Overhead loudspeakers are used to provide voice reinforcement.
   D. Additional program requirements (e.g. higher powered speakers and subwoofers, stage monitors, additional microphones, etc.) are accommodated by a patching system, loudspeaker plug boxes on stage and in the auditorium used with portable equipment.

2. MIXING & PLAYBACK EQUIPMENT
   A. A thirty-two input digital mixing console in the Control Booth combines signals from live microphones, prerecorded material, and audio special effects. These signals can be assigned through a matrix to the main loudspeaker system and portable equipment.
   B. An operable window allows the sound mixer to hear rehearsal and performance sound which reasonably represents the audience experience.
C. For more critical applications, the mixing console may be located outside the Control Booth by extending the connections and removing seats in the back row.

D. The mixing console may also be operated from the performance area via plug boxes on the stage.

E. A complement of AV sources, appropriate to program needs is provided, including: Blu-ray player, and compact disc recorder with iPod dock.

F. A PTZ camera provides views of the stage.

3. ADA COMPLIANT AUDIO SYSTEM

A. This system transmits stage sound or other selected program material, by means of infrared light to individual receivers provided for the hearing impaired.

B. The ADA system can also be used for transmission of narration and stage sound or other selected program material to individual receivers provided for the sight impaired.

4. INTERCOM SYSTEM

A. The technical intercom system supplies two channels of two-way communication among technical operating personnel through wired belt packs connected to headsets with boom-mounted microphones. Plug boxes or stations are provided for all technical operating positions in the stage, house, control booths, and other key areas.

5. MICROPHONES

A. A complement of wired and wireless microphones, stands, cables, adapters, and accessories, appropriate to program needs, is provided.

6. AV DISTRIBUTION AND CONTROL

A. A video network receives video signals the stage area or control booth. These sources are distributed to projectors, flat panel displays, recorders, and other devices as needed.

B. A small touch panel provides access to video signal routing matrices and preset assignments.

C. A network switch connects video sources for control.

7. VIDEO PROJECTION

A. A 1-DLP HD projector mounted in the Control Booth provides for projection of video sources.

8. PROJECTION SCREEN

A. A motorized, ceiling recessed front projection screen is included.
9. AV CAPTURE & STREAMING
   A. An AV capture system allows stereo audio and HD video to be recorded locally to a disc-based recording system, stored via network server, and/or streamed live.
   B. These signals can be interfaced with a third party network server with asset management software.

10. TEACHING STATION
    A. A teaching station (specified by ETSU) with gooseneck microphone, control panel, and connection for laptop computer and other AV sources allows for a presenter to control the main auditorium multi-media AV and sound reinforcement systems.

11. AV EQUIPMENT HUBS
    A. Additional AV equipment, required to interface all of the above systems, is located in the sound and light lock outside of the Control Booth.
    B. The equipment installed in this location includes: signal processing, amplifiers, plug boxes, patch bays, cable assemblies, video monitors, racks, computers, and other infrastructure.
    C. A computer-based system allows remote monitoring, control, and diagnostic testing of the AV system. In addition, this system stores default presets, settings, and programs, and can be used to address most of the AV processing devices.

12. TERMINATIONS & CABLE INTERFACE
    A. Plug boxes and terminations are located on the stage and in the auditorium provide hardwire connectivity for AV signal transport among the various locations.
    B. Most AV signals terminate in equipment racks where signals can be routed to various destinations via patch bays and patch cables.
    C. A variety of cable assemblies interface AV equipment with the infrastructure.

13. POWER DISTRIBUTION SYSTEM
    A. Backup-UPSs have been included for equipment protection and proper shutdown in the event of a power failure.

14. ESTIMATED COST OF INSTALLED AV EQUIPMENT LISTED ABOVE ..... $225,000

V. AUDIO PROGRAM, PAGING, & SHOW RELAY
Spaces include: Lobby; Main Auditorium, Studio Theater, and Recital Hall common green rooms, dressing rooms, offices, adjacent corridors, and support spaces.

1. LIVE ROOM MICROPHONE SYSTEMS
   A. A stereo microphone suspended in the audience area of each performance space picks up signals from rehearsals and performances, both amplified and unamplified. Signals from these microphones are distributed as needed to the local ADA systems, archive recording systems, intercom, control rooms, and to the lobby and common backstage areas.
2. VIDEO FEEDS
   A. Cameras in each performing space transmit rehearsal and performance video to
local archive recording systems, control rooms, and to the lobby and common
backstage areas.

3. LOBBY AND BACKSTAGE AREAS
   A. Audio and from the three performance spaces or from other discrete sources is fed
to loudspeakers mounted in the walls or ceilings of selected areas.
   B. Video from the three performance spaces or from other discrete sources are fed
to flat screen displays in selected areas.
   C. Audio and video sources may be assigned via a DSP and AV matrix switcher to
the selected areas as required.

4. ESTIMATED COST OF INSTALLED AV EQUIPMENT LISTED ABOVE ........ $45,000

VI. RECORDING FACILITY
A separate Recording Studio is not included in the project. However, a combination of
portable and fixed equipment is included for tracking performances in the performance
spaces and recording them to a multi-track for post editing elsewhere. This equipment
includes a basic assortment of recording microphones and stands, pre-amplifiers, A/D
converters, and hard disk recorders.

1. ESTIMATED COST OF PORTABLE RECORDING EQUIPMENT ............... $75,000

VII. INSTRUMENT & CHORAL REHEARSAL ROOMS
The installed systems in each room consist of the following major components.

1. TEACHING STATION
   A. A standard teaching station (specified by ETSU) will house the equipment and
connections for all AV functions in this room. Systems and functions include:
      1) Fixed microphones for vocal amplification and music recording.
      2) A 7-inch touch panel for access to audio and video signal routing matrices and
         preset assignments.
      3) A connection for laptop computer which allows a presenter to control the room’s
         multi-media AV and sound reinforcement systems.
      4) An assortment of equipment for the creation and/or playback of audio and video
         recorded material, including: compact flash recorder, compact disc recorder
         with iPod dock, DVD/Blu-Ray player.
      5) An AV capture system allows stereo audio and HD video to be recorded locally
to a disc-based recording system, stored via network server, and/or streamed live.
6) An AV matrix switcher to receive sources from the teaching station. These sources are distributed to the projector located within the room. Selected audio and video signals will also be available in the Recording Studio for remote recording.

2. LOUDSPEAKERS
   A. Stereo wall mounted loudspeakers are included for audio reproduction during classes and rehearsals.
   B. Additional sound reinforcement functionality is supported by portable equipment, as needed.

3. VIDEO PROJECTION
   A. Two 1-DLP HD projectors provide for projection of video sources.

4. PROJECTION SCREEN
   A. Two motorized front projection screens flank the teaching wall at angles to facilitate ensemble sightlines.

5. TERMINATIONS & CABLE INTERFACE
   A. Plug boxes in the ceiling are provided for the deployment of additional recording microphones.
   B. Terminations in the Teaching Station provide hardwire connectivity for local recording, AV signal transport back to the Recording Studio, and connection to Portable Systems.

6. ESTIMATED COST OF INSTALLED AV EQUIPMENT LISTED ABOVE ..... $125,000

VIII. PERCUSSION REHEARSAL ROOM

The installed systems for the Percussion Rehearsal Room are similar to the Instrument and choral rehearsal rooms, but use only a single screen on the teaching wall.

1. ESTIMATED COST OF INSTALLED AV EQUIPMENT LISTED ABOVE ...... $50,000

IX. FACILITY WIDE PORTABLE AV EQUIPMENT POOL

1. AV EQUIPMENT COMPLEMENT
   A. A complement of portable AV equipment will be packaged in rolling racks and cases and provides the capability to meet additional program requirements beyond the basic systems in the Main Auditorium, Studio Theater, and Recital Hall.
   B. The system can also be used to supplement the rehearsal spaces and provide robust stand-alone reinforcement systems for use in the lobby or elsewhere in the facility.
   C. This equipment complement is scalable and will be comprised of similar makes and models deployed elsewhere in the facility, providing operational continuity and emergency backup capability.
D. Equipment complement includes:
   1) Loudspeakers, associated amplifier/controllers, stands, mounting hardware, and cable
   2) Digital Mixing Consoles
   3) AV sources, switching, and control
   4) Wired and wireless microphones, stands, cables, adapters, and accessories
   5) Video projectors
   6) Projection screens

2. ESTIMATED COST OF AV EQUIPMENT LISTED ABOVE.......................... $85,000

X. ADDITIONAL INFORMATION FOR PURPOSES OF COST ESTIMATION

The following information describes additional cost items associated with the installation of the AV systems. These items are designed and/or specified by other members of the design team. The costs of these items are not included in the Division 27 AV Systems estimates.

1. ARCHITECTURAL SPACES FOR AV EQUIPMENT
   A. The AV control booth is a highly specialized room, acoustically treated and isolated. It houses both fixed and portable AV equipment used for show operations, sound mixing, and recording. An operable window opens directly into the audience chamber. It is typically located at the rear of the audience seating area on the orchestra level. This room is approximately 120 square feet.
   B. The AV rack room contains all of the large, power consuming, heat producing AV components. It is typically located in the stage house area or adjacent to the AV control booth. This room is approximately 100 square feet.
   C. The house mixing position is an AV operations area in the audience chamber. Portable sound mixing consoles, processing gear, and operators will be located in this area when programming dictates. This space requires easy rolling access to a flat floor surface.
   D. Cost estimates for these spaces should be provided by the architect.

2. HVAC SYSTEMS FOR AV EQUIPMENT
   A. The mechanical engineer will design and specify HVAC systems for rooms containing AV equipment. These rooms ideally should be maintained at an ambient temperature between 60 and 80 degrees Fahrenheit, and at a relative humidity between 40% and 55%, non-condensing. These environmental requirements are in effect 24 hours a day and usually necessitate a separate air handling system for each room containing AV equipment.
   B. The estimated total heat loads generated by AV equipment are as follows:
      1) AV equipment in the Public Lobby will not exceed .5 kW.
      2) AV equipment in the Main Auditorium will not exceed 2 kW.
      3) AV equipment in the Studio Theater will not exceed 1 kW.
4) AV equipment in the Recital Hall will not exceed 1 kW.
5) AV equipment in the Instrument Rehearsal Room will not exceed .5 kW.
6) AV equipment in the Percussion Rehearsal Room will not exceed .5 kW.
7) AV equipment in the Auditorium rack room will not exceed 10 kW.
8) AV equipment in the Studio Theatre rack room will not exceed 4 kW.
9) AV equipment in the Recital Hall rack closet will not exceed 2 kW.
10) These heat loads are for equipment only and do not include normal requirements for lighting or personnel.

C. Cost estimates for these HVAC systems should be provided by the mechanical engineer.

3. MOUNTING ACCOMMODATIONS FOR AV EQUIPMENT
   A. The structural engineer will specify blocking and bracing for support of AV equipment as follows:
      1) Upper and lower loudspeaker arrays on left proscenium wall not exceeding 300 pounds each.
      2) Upper and lower loudspeaker arrays on right proscenium wall not exceeding 300 pounds each.
      3) Center loudspeaker array not exceeding 500 pounds each.
   B. Cost estimates for these mounting accommodations should be provided by the structural engineer.

4. RIGGING SYSTEMS FOR AV EQUIPMENT
   A. The theater consultant will specify the following items for use with the AV equipment.
      1) Motorized winch with two lift lines for loudspeaker array at center proscenium. Total weight will not exceed 500 pounds.
      2) Motorized winch with two lift lines for fixed frame projection screen over stage area. Total weight not to exceed 400 pounds.
      3) Independent control for each winch, with five programmable preset stop positions.
   B. Cost estimates for these rigging systems should be provided by the theater consultant.

5. IT SYSTEMS FOR AV EQUIPMENT
   A. The IT designer will specify the following items for use with the AV equipment.
      1) Outlet types and wall jacks for connection of AV Equipment to the building network.
      2) Cable types and closet destination.
      3) Router/switch for connection of AV Equipment to building network.
B. Cost estimates for these IT systems should be provided by the IT designer or electrical engineer.

6. ELECTRICAL SYSTEMS FOR AV EQUIPMENT

A. The electrical engineer will specify the following items for exclusive use by the AV equipment. Design criteria will be supplied by the AV designer.

1) AV technical power system fed from K-13 rated isolation transformers with copper windings and electrostatic shield. Three separate systems are required: one for the concert hall, one for the studio theatre, and one for the recital hall. The rehearsal rooms will be on common power (not AVTP).
   a) The estimated total load of all AV equipment connected to these devices will not exceed 45 kVA in the concert hall, 30 kVA in the studio theatre and 15 kVA in the recital hall.

2) AV technical power isolated grounding system.

3) AV technical power panel board for the AV systems.

4) Empty conduit and raceway systems (with pull strings) connecting all AV equipment terminations. (Note that the wire and wire-pull labor for low voltage AV cables are included in the installed AV systems cost estimate.)

B. Cost estimates for these electrical systems should be provided by the electrical engineer. However, the specific electrical system requirements for Division 27 AV systems cannot be fully valued until coordinated design documents are issued. Until such time, Acoustic Distinctions offers an interim placeholder based upon our experience with recent projects of this scope. This placeholder estimates the Division 26 costs associated with providing the AV technical power system and the empty conduit/raceway system, and may fluctuate depending upon current market conditions. This estimate is not part of Division 27 AV Systems.

7. UTILITY SYSTEMS

A. Utility systems, such as: telephone, data transmission, fire and emergency, computer control, security, MATV, etc. are not covered in the above estimates. The design and specification of these systems are by others.
### XI. SUMMARY STATEMENT OF PROBABLE COST FOR AV SYSTEMS

<table>
<thead>
<tr>
<th>Division 27 AV Systems</th>
<th>Cost Estimate¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Lobby</td>
<td>$35,000</td>
</tr>
<tr>
<td>Main Auditorium</td>
<td>$400,000</td>
</tr>
<tr>
<td>Studio Theater</td>
<td>$200,000</td>
</tr>
<tr>
<td>Recital Hall</td>
<td>$225,000</td>
</tr>
<tr>
<td>Audio Program, Paging, and Show Relay</td>
<td>$45,000</td>
</tr>
<tr>
<td>Recording Facility</td>
<td>$75,000</td>
</tr>
<tr>
<td>Instrument and Choral Rehearsal Rooms</td>
<td>$125,000</td>
</tr>
<tr>
<td>Percussion Rehearsal Room</td>
<td>$50,000</td>
</tr>
<tr>
<td>Facility Wide Portable Equipment Pool</td>
<td>$85,000</td>
</tr>
<tr>
<td>AV Technology Advancement Contingency</td>
<td>$120,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$1,360,000</strong></td>
</tr>
</tbody>
</table>

¹ **CLARIFICATION** – These estimates do not include: winches, rigging, technical power, cable raceways, taxes, bonding, mark-ups, construction contingencies, inflation, or allowance for unusual contractual requirements included in the specification general conditions.

<table>
<thead>
<tr>
<th>Related Systems</th>
<th>Cost Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architectural Spaces for AV Equipment</td>
<td>by others</td>
</tr>
<tr>
<td>HVAC Systems for AV Equipment</td>
<td>by others</td>
</tr>
<tr>
<td>Rigging Systems for AV Equipment</td>
<td>by others</td>
</tr>
<tr>
<td>IT Systems for AV Equipment</td>
<td>by others</td>
</tr>
<tr>
<td>Electrical Systems for AV Equipment</td>
<td>$330,000²</td>
</tr>
</tbody>
</table>

² **CLARIFICATION** – This is an interim placeholder for inclusion in Division 26 Electrical estimates and includes all deferred equipment. This estimate is not part of Division 27 AV Systems.